Delta RMP Annual Joint Meeting of the Technical Advisory Committee and Steering Committee

October 29, 2018
9:30 am – 5:00 pm

(Please plan to arrive 10-15 minutes early to pass through security.)

Cal/EPA Building
First Floor Training Room (East/West)
1001 I Street,
Sacramento, CA 95814

Join the meeting: https://join.me/sfei-conf-cw2
To dial in by phone: +1.415.594.5500
Conference ID: 238-626-034 #

Agenda

1	**Introductions and Review Agenda** Introduce TAC and SC members, establish quorum, and explain goals of the meeting		9:30 – 9:40 Gita Kapahi
2	**Welcome to new Delta RMP participants** In the past year, several new organizations/ agencies have joined the program as contributing members. The coordinating committee has suggested adding 3 seats to represent agencies engaged in "flood control and habitat restoration." The main participant in this new category is the Department of Water Resources (DWR) with its annual $200,000 contribution. Desired outcome: • Informed committee on rational for modifying the Delta RMP Charter to create a new participant category	Memo on DWR participation	9:40 – 9:45 Patrick Morris

3	**Decision: Charter Update** Threes updates to the Charter have been requested by staff and the co-chairs to (1) add 3 new voting members to the Steering Committee representing "flood control and habitat restoration," (2) allow for a single TAC chair rather than requiring co-chairs, and (3) allowing alternates for SC co-chairs. Desired outcome: • Approve update(s) to the Charter	Memo on Charter Updates	9:45 – 10:00
4	**Decision: Approve Steering Committee Meeting Summary** from July 17, 2018 and confirm/set next meeting dates Desired outcomes: ● Approve meeting summary ● Confirm upcoming meeting dates: ● Pesticides Subcommittee with Deltares: Nov 9, 2018, Cal/EPA ● TAC: Dec 12, 2017, Regional San ● SC: Jan 23, 2018, CV Regional Board	*Draft Summary of July 17, 2018 SC Meeting	10:00 – 10:05 Adam Laputz
5	**Information: Financial Update** The Financial Update memo summarizes the balance of budgeted and reserved RMP funds as well as the status of revenue received. The Financial Subcommittee may also briefly report out on their findings and recommendations. Desired outcomes: • Informed committee • Vote to unencumber $37,743 surplus from FY17/18 and transfer to the Undesignated Reserve Fund.	Quarterly Finance Update Memo	10:05 – 10:20 Matthew Heberger
6	**Project Progress Update** Report by ASC on the implementation of the workplan to date, including update of the Quality Assurance Program Plan (QAPP) to cover pesticides and toxicity, monitoring Contaminants of Emerging Concern (CECs), progress on the Pesticides Interpretive Report by the contractor Deltares, and recent grant proposal submissions. Desired outcomes: • Input on timing of milestones and key opportunities for input	Project Schedule (Gantt Chart) including milestones, deliverables	10:20 – 10:50 Matt Heberger
	Break		10:50 – 11:00
7	**Information: Technical Advisory Committee Update** Desired outcomes: • Inform the SC on key outcomes of the September 21, 2018 TAC meeting • Report by the Data Management Subcommittee	*Draft Summary of Sept 28, 2018 TAC Meeting*	11:00 – 11:30 Stephen McCord

* Draft reports and meeting summaries distributed to Steering Committee and TAC members only.

8	**Decision: Expanding Mercury Monitoring in FY18/19** Mercury monitoring is underway to address the highest priority information needs related to implementation and revision of the Delta Methylmercury TMDL. The mercury subcommittee is requesting funds to increase the frequency of water sampling from 8 times per year to 10. This will strengthen the "linkage analysis" between mercury in water and fish tissue. This is the key to understanding how methylmercury inputs from various pathways may impair beneficial uses, and is essential to management and the TMDL. Current funding for FY18/19 mercury monitoring is $277,210. An additional $46,588 is sought for 2 additional sampling events per year, bringing the total to $323,798. Desired Outcome: • Steering Committee vote to approve expanded mercury monitoring.	Delta RMP FY18/19 Workplan, Attachment B, Mercury Monitoring	11:30 – 11:45 Jay Davis
9	**Discussion: Anticipated management decisions and policies, and related information needs** The Draft Multi-Year Plan contains a list of upcoming management decisions relevant to the RMP. Steering Committee members will be asked to talk about their highest priority management decisions and to identify any issues that are missing from the list. Desired outcomes: • Consensus on management drivers and drivers for the Delta RMP. • Prioritized management decisions to inform the Delta RMP in the next 5 years	Draft Multi-Year Plan	11:45 – 12:30 Matthew Heberger
	Lunch Please make your own arrangements for lunch.		12:30 – 1:30
10	**Decision: Setting Planning Budgets for Delta RMP Focus Areas** To be efficient in proposal development and workgroup meetings, the Steering Committee needs to set clear planning budgets for each of the focus areas (nutrients, mercury, pesticides and toxicity, and CECs). Desired outcome: • SC direction on planning budgets for monitoring and special studies for the upcoming fiscal year. • Direction to the TAC on topics that are high priority for the Steering Committee	Draft Multi-Year Plan	1:30 – 2:30 Adam Laputz

11	**Decision: Approve publication of Pathogens Monitoring Final Report** This study by Larry Walker Associates was designed to fulfill the dual purposes of characterizing ambient conditions for pathogens (*Cryptosporidium* and *Giardia*) throughout the Delta and to satisfy regulatory requirements. On 9/21, the TAC recommended approving and publishing the report. Desired outcome: • SC decision to approve and publish the report.	*Revised Final Draft Pathogens Report	2:30 – 2:45 Brian Laurenson Hope McCaslin Taylor
12	**Decision: Approve public release of FY16/17 Pesticides Data** Pesticides chemistry data from Year 2 of Delta RMP monitoring has been made available online via the USGS' National Water Information Service (NWIS). In keeping with the Delta RMP Communications Plan, ASC will make program data publicly available after review by the TAC and approval by the SC. Note that in July 2017, the SC voted not to produce a Year 2 data report, but instead to support the creation of a web-based "data visualization" tool. Desired outcomes: • Recommendation from the TAC to the SC to approve and publish the dataset. • SC decision to approve and publish the dataset.	*Spreadsheet of FY16/17 Pesticides Chemistry Data* *Memo from ASC QA Officer *Pesticides Dataviz[†]	2:45 – 3:00 Matt Heberger
13	**Information: Human Health Impacts of Contaminants** This agenda item was suggested by members of the Pesticides Subcommittee. Delta RMP mercury monitoring has been specifically designed around understanding the human health impacts of consumption of contaminated sportfish. While human health is also relevant to study of pesticides and CECs, these programs have been designed primarily to investigate impacts to ecosystems. We will hear from an expert in the field of drinking water quality and discuss whether to add an assessment question related to human health. **Desired outcome:** • Informed committee	Presentation by Dr. Bruce Macler, US EPA	3:00 – 4:00 Gita Kapahi
	Break		4:00 – 4:15

[†] Matt H. sent a link to download the dataviz app via email to the SC, TAC, and Pesticides Subcommittee on July 14, 2018, and has given demos for the Pesticides Subcommittee and TAC. This dataviz has not been made publicly available or posted online—in order to view it you must download the files onto your computer and open it in a browser.

The purpose is to visualize the first 2 years of Delta RMP Pesticides data, and it is meant to be simple and easy to use. It shows results for the 152 synthetic organic pesticides analyzed by the USGS Organic Chemistry Research Laboratory (OCRL). The app lets you compare observations to EPA's Aquatic Life Benchmarks, or a custom threshold of your choice. Note that it does not show toxicity data or copper, nor does not show QA flags. These were considered beyond the scope of this simple tool which was created *pro bono* at no expense to the program.

14	**Pulse of the Delta and External Communication** In FY17/18, the SC budgeted to begin production of *The Pulse of the Delta*. The Pulse is intended to focus on water quality of the Delta, highlight the Delta RMP's accomplishments, and outline where we are going in the future. Last fall, the SC decided to delay production of the Pulse pending the completion of several reports. We will discuss key messages of the *Pulse* and consider the format, i.e. print publication vs. web. **Desired outcome:** • SC direction on the desired format and key messages for the *Pulse*.	Presentation: *Planning the Pulse of the Delta*	4:15 – 4:55 Matt Heberger
15	**Plan Agenda Items for Upcoming SC / TAC Meetings** Desired outcome: • Suggested items for discussion or decision at upcoming meetings.		4:55 – 5:00 Gita Kapahi
	Adjourn		5:00

Materials for Agenda Item 2

To: Delta RMP Steering Committee

From: Patrick Morris, CVWRCB

Date: October 10, 2018

DWR Participation in the Delta RMP and Request for Three Seats on the Steering Committee

Background

The Central Valley Regional Water Quality Control Board (Regional Board) is requiring the Department of Water Resources (DWR) to participate in the Delta Regional Monitoring Program (Delta RMP). The Regional Board will implement this requirement through Clean Water Act Section 401 Water Quality Certification conditions for all 401 certifications issued to DWR for Eco-restore, flood control, wetland restoration, and fish passage projects planned for the Delta and Yolo Bypass and surrounding area. These projects may have both short-term and long-term cumulative impacts on Delta water quality.

The Regional Board approved DWR's 18 August 2018 Participation Plan that commits an annual contribution of $200,000 to cover Delta RMP participation. See Attachment A for the list of about 20 proposed and pending Eco-restore, flood control, wetland restoration, and fish passage projects that are covered by this Delta RMP requirement. The Participation Plan and annual fiscal contribution eliminate the need to identify project-specific Delta RMP participation requirements for each 401 Water Quality Certification.

In September, DWR submitted a second Participation Plan to satisfy the requirement for Delta RMP participation per the 401 Water Quality Certification for the Temporary Barriers Project. In the 14 September 2018 Participation Plan, DWR committed to providing in-kind staff labor to complete five tasks. The in-kind tasks include additional hydrodynamic modeling and collaboration with the Aquatic Science Center (ASC) and Central Valley Regional Board staff to enhance the Delta RMP's current nutrient modeling efforts as described in the Delta RMP FY18/19 Workplan and Budget. Other sampling and reporting tasks will inform the Central Valley Regional Board Nutrient Research Plan's priority research needs that align with the Delta RMP Nutrient Subcommittee's assessment questions.

In addition to committing a $200,000 annual contribution, DWR's proposal letter requested three seats on the Delta RMP Steering Committee. These new seats would be added under a new participant category called "Flood Control and Habitat Restoration". This new participant category will cover numerous DWR Eco-restore, flood control, wetland restoration, and fish passage projects.

Currently, Steering Committee membership is comprised the following breakdown of participant 'categories' and the number of seats for each. The number of seats on the Steering Committee per participant category should be based on the level of contribution (both technical and financial); potential impacts to water quality; and the benefits resulting from the comprehensive, coordinated monitoring efforts rather than the number of agencies or entities within a participation category. Delta RMP participation by DWR staff has already proven to be beneficial in seeking more collaborative monitoring opportunities and add to the existing knowledge and expertise of our technical advisory committees. DWR's financial contribution is comparable to other participant categories with a similar number of seats.

Table 1. Current and Proposed Delta RMP Participating Categories

Participant Category	Number of seats	2018 Total Contributions
Proposed		
Flood Control and Habitat Restoration	3	$200,000 (plus $102,689 In-kind from Temporary Barriers)
Current		
Stormwater	3	$491,399
Regulatory Agencies	3	$315,000 (SWAMP funding)
Wastewater	3	$197,076
Agriculture	2	$148,780
Dredgers	1	$63,000
Resource Agencies	1	N/A
Water Supply	1	N/A
Coordinated Monitoring	1	N/A

Recommendation

The Steering Committee should consider adding a "Flood Control and Habitat Restoration" participant category and three seats for DWR's participation in the Delta RMP.

Materials for Agenda Item 3

AQUATIC SCIENCE CENTER

Date: October 18, 2018

To: Delta RMP Steering Committee

From: Matthew Heberger

Re: Proposed changes to the Delta RMP Charter

On behalf of the Coordinating Committee (co-chairs and staff), we request to the Steering Committee to consider approving the following edits to the Delta RMP Charter.

1. To add 3 new seats to the Steering Committee.

This change is requested to add a new participant category.

2. Definitions:

j. *"Participants"* means individual agencies or organizations that provide financial contributions and/or in-kind services for Delta RMP activities, which includes regulatory agencies, resource agencies, water suppliers, coordinated monitoring programs, wastewater treatment agencies, stormwater municipalities, dredgers, flood control and habitat restoration, and irrigated agriculture coalitions.

k. *"Participant Groups"* means groups of similar types of Participants such as publicly owned treatment works (POTWs), stormwater agencies, agricultural coalitions, water suppliers, dredgers, coordinated monitoring programs, flood control and habitat restoration, and regulatory agencies.

7.A.1 Steering Committee Membership:

- 3 seats for flood control and habitat restoration

Figure 1. Steering Committee box:

3 seats- Flood Control and Habitat Restoration

2. Consider a change to the Charter so that the TAC does not require co-chairs, and can be chaired by a single person. This change is desired as our former co-chair has stepped down and there have been no volunteers to step up. It will make the program governance documents match the reality of the situation, which seems to be working well at present. We may choose to permanently codify having one chairperson, or we can word the Charter such that 2 co-chairs are desirable, but 1 chair is sufficient for doing business if a second co-chair cannot be found.

7.A.4. Steering Committee Subcommittees:

TheA TAC co-Chair may attend by invitation of the Coordinating Committee.

7.B. Technical Advisory Committee (TAC):

The Coordinating Committee communicates SC direction to the TAC through the Implementing Entity and the TAC Co-Chairs.

7.B.3 TAC Co-Chairs

The Co-Chairs Chairperson coordinates the TAC's oversight of the technical content and quality of the RMP, co-chair TAC meetings, and help ensure review of all program proposals and technical products. They also provide a communication link between the SC, TAC and Implementing Entity as members of the Coordinating Committee and help ensure consistencies and resolve timing and scheduling issues between the SC, TAC, and subcommittees. The members of the TAC will appoint two Co-Chairs a Chairperson for a two-year term. The selection of the Co-Chairs is subject to review by the Steering Committee. The Co-Chairs can serve indefinitely with the support of the TAC and the SC. A qualified Co-Chair has a broad understanding of scientific issues in the Delta and can provide strong leadership, meeting management, and direction to the group.

7.B.6 TAC Decisions

The TAC Co-Chairs will coordinate with the Coordinating Committee to ensure that the meeting summary prepared by the Implementing Entity adequately documents majority and minority viewpoints of the seated representatives.

Figure 1. Organizational Chart of the Delta RMP

1 Chairperson 2 co-chairs

Attachment 2: Roster of Technical Advisory Committee Members (updated March 2018)

Stephen McCord, Co-cChair

3. Allow for alternates for Steering Committee Co-Chairs

This change was requested by the current co-chairs, who feel that this change will allow for more continuity when the chairs are unable to participate in meetings.

7.A.3 Steering Committee Co-Chairs

Steering Committee Co-Chairs serve as chair of the meetings, facilitate discussion, and encourage members to participate in discussions. The Co-Chairs have an oversight role and are responsible for the overall functioning of the committee. The SC will select or reaffirm the Co-Chairs once per year using its decision-making process. Co-Chairs have no term limits and may continue to serve annual terms indefinitely with support of the SC. One Co-Chair represents a regulatory Participant Group and one Co-Chair represents a regulated Participant Group.

Each elected co-chair may designate an alternate to help fulfill their duties, for example when the co-chair is unable to attend a meeting. Co-chair alternates must also be selected and reaffirmed once per year by the Steering Committee. The co-chair's alternate shall exercise the rights and responsibilities of the co-chair in his or her absence.

Materials for Agenda Item 5

DATE: October 15, 2018

TO: Delta RMP Steering Committee

THROUGH: Delta RMP Finance Committee

FROM: Matthew Heberger, Program Manager, Aquatic Science Center

RE: Summary of Delta RMP Financials for the period ending Sept. 30, 2018

This memorandum provides an update of budgets and expenses for the Delta RMP and the balance of the Undesignated Reserve Fund. The figures in this memo are current through September 30, 2018. It provides a "closeout" of the FY17/18 annual budget and covers the first quarter of FY18/19.

Delta RMP FY17/18 Budget

The last finance memo covered through the end of May 2018. This report "closes out" several completed tasks authorized in the FY17/18 workplan and provides a year-end summary.

Revenue

We still expect to receive payments for contributions to the Delta RMP for FY17/18. We will continue to track these and follow up until these dues have been paid. To date, we have received **$928,575**. Expected and received revenue is summarized below in Table 1.

We still expect to receive $80,000 from one Delta RMP participant, the State and Federal Contractors Water Agency (SFCWA)'s successor agency, the State Water Contractors (SWC), upon completion of 2 key deliverables, a Draft Pesticide Interpretive Report, and a Draft Pesticide Monitoring Design. We invoiced SWC for $20,000 in July of 2018, but have not yet received payment, although SWC staff have confirmed that they are processing the invoice and expect to send this payment soon. The final invoice for $60,000 can be sent upon receipt of the Draft Pesticide Interpretive Report, expected to be delivered by our subcontractor Deltares in April 2019.

Table 1 Delta RMP revenue for contributions due in FY17/18 by participant group, through 9/30/2018

Category	*Expected*	Received	Total
Interest Income		$11,319	$11,319
Dredgers		$60,000	$60,000
ILRP		$148,780	$148,780
MS4 Phase 1		$181,400	$181,400
MS4 Phase 2		$309,999	$309,999
POTW		$197,077	$197,077
Water Supply	*$80,000*	$20,000	$100,000
Total	***$80,000***	**$928,575**	**$1,008,575**

Planned **Expenses for Tasks Authorized in FY17/18**

The planned expenses for tasks authorized in the original FY17/18 workplan totaled **$863,165**. Since the workplan was published in May 2017, ASC and the Finance Committee made several changes to the budget based on updated plans and priorities. A summary of these changes is shown in Table 2 below. (Note that there is no change to Table 2 since last quarter's finance update.) The net fiscal impact of these changes been to add $23,000 in new expenses. In addition, we rolled over several incomplete tasks from previous fiscal years into the FY17/18 budget. After these two changes, the total planned expense for tasks authorized in FY17/18 was **$1,158,660**.

FY17/18 Workplan Planned Expenses	$863,165
Amendments to the FY17/18 Workplan (net)	$23,000
Rollover Tasks from FY15/16 and FY16/17	$272,495
Total planned expenses	**$1,158,660**

In the past quarter, the Finance Committee recommended against continuing this approach to amending budget lines during the year. ASC staff will continue to work with the Committee on ways to streamline and simplify reporting.

We recommend breaking the core functions into a single year-long "project" for the purposes of reporting. Monitoring projects and special studies will each be separate standalone projects with durations of 1.5 to 2 years. This will allow us to report more realistically on project progress, burn rates, and actual vs. planned expenses over the actual lifetime of each task.

Table 2 Changes to the FY17/18 Workplan planned expenses, by subtask, after it was published in May 2017.

Budget Line	Budget in Workplan	New Budget amount	Description
Task 1A, Program Planning	$65,000	$67,500	$2,500 added to budget to cover additional time and effort in planning and coordinating monitoring designs for pesticides and CECs. Previously, $10,400 was transferred from planned ASC labor to a subcontract with a consulting statistician.
Task 2A , SC Meetings	$48,484	$44,734	$3,750 transferred to Task 176D, Pesticides Data Management
Task 2B, TAC Meetings	$61,620	$57,870	$3,750 transferred to Task 176D, Pesticides Data Management
Task 2C, Technical Subcommittee Meetings	$20,000	$22,500	$2,500 added to budget to cover expense of additional subcommittee meetings and preparation of background materials – 7 pesticides subcommittee meetings, 4 of which were in person.
Task 3D, Data Management Subcommittee	--	$5,000	New budget line created in Apr 2018. The Steering Committee requested the creation of a new subcommittee covering data management and quality assurance. This new subtask covers ASC staff time to plan and coordinate meetings, respond to requests from stakeholders for information, and plan and document new data management procedures.
Task 4B, Stakeholder Board Meetings	$10,000	$5,000	There has not been much demand for this service envisaged in the workplan. $2,500 transferred to each Task 1A and 2C.
Task 4C, Data Assessment Framework Workshop	--	$5,000	New budget line added in Dec 2017. Created at the request of the coordinating committee. This subtask is intended for ASC staff time to help plan and coordinate the upcoming Data Assessment Framework Workshop requested by the Steering Committee
Task 8A, Pesticides Interpretive Report	$60,000	$80,000	Budget amount increased in Jan 2018. To be used entirely to hire a subcontractor to ASC perform analyses and write the Pesticides Interpretive Report.
Task 8B, Contract Management (NEW)	--	$8,000	New budget line created in Jan 2018. 10% of contract -- covering ASC staff time to help write and issue the request for proposals (RFP), select a contractor, and contract administration for the Pesticides Interpretive Report.
Task 176D, Data management and QA	$7,151	$14,651	$7,500 added to budget. Transferred from Tasks 2A and 2B, in order to cover overage.
Task 176E, Reporting	$20,000	$5,000	Budget amount decreased in Jan 2017. The Year 2 pesticides data report was cancelled by the Steering Committee. However, ASC is still obligated to produce a QA memo and to distribute draft data to the TAC and coordinate feedback on the UCD toxicity lab report.
Total	$80,000	$103,000	Net fiscal impact: Added $23,000 in new expenses.

Actual Expenses for Tasks Authorized in the FY17/18 Workplan

The program has spent **$815,326** through Sept 30, 2018.

Table 3 shows a summary of the planned and actual year-to-date (YTD) expenses **by category**.

Table 4 shows budget vs. expenses **by task**. **Figure 1** shows budget and expenses **by task** for the first two quarter of the fiscal year. (Figure 1 shows the same information as in Table 4 in graphical form.)

Table 9, at the end of this memo, reports more detailed information on the budget and expenses at the **subtask** level. Gray rows in **Table 9** indicate tasks that are complete and closed to further billing. This table also provides details on expenses for the period since the last report in terms of ASC labor (hours spent), invoices paid, and outputs and deliverables.

Table 3 Summary of planned and actual expenses (staff and subcontractors billing) for tasks approved in the FY17/18 workplan, through 9/30/2018.

	Planned expense	Actual Expense	Budget remaining	Percent spent
Direct Cost	$2,500	$876	$1,624	35%
Labor (ASC)	$444,987	$363,620	$81,367	82%
Subcontracts	$711,174	$450,831	$260,343	63%
Total	**$1,158,661**	**$815,326**	**$343,335**	**70%**

Table 4. Planned and actual expenses (staff and subcontractors billing) for tasks authorized in the FY17/18 workplan, through 9/30/2018.

Task	Planned expense	Actual Expense to date	Percent of Budget Spent
01. Core Functions	$121,500	$123,055	101%
02. Governance	$135,104	$118,880	88%
03. Quality Assurance	$35,000	$36,663	105%
04. Communications	$50,500	$6,056	12%
08. Year 1-2 Pesticides Interpretive Report	$88,000	$9,089	10%
09. Nutrients	$230,000	$181,356	79%
10. Mercury Monitoring FY17/18	$233,561	$143,996	62%
166. CUP Monitoring (authorized in FY15/16)	-$1,745	$812	-47%
173. Quality Assurance (authorized in FY16/17)	$13,434	$15,975	119%
174. Communications (authorized in FY16/17)	$4,084	$2,412	59%
176. CUP Monitoring (authorized in FY16/17)	$172,428	$131,019	76%
177. Nutrient Synthesis (authorized in FY16/17)	$42,237	$10,494	25%
178. Mercury (authorized in FY16/17)	$34,557	$35,521	103%
Total	**$1,158,660**	**$815,326**	**70%**

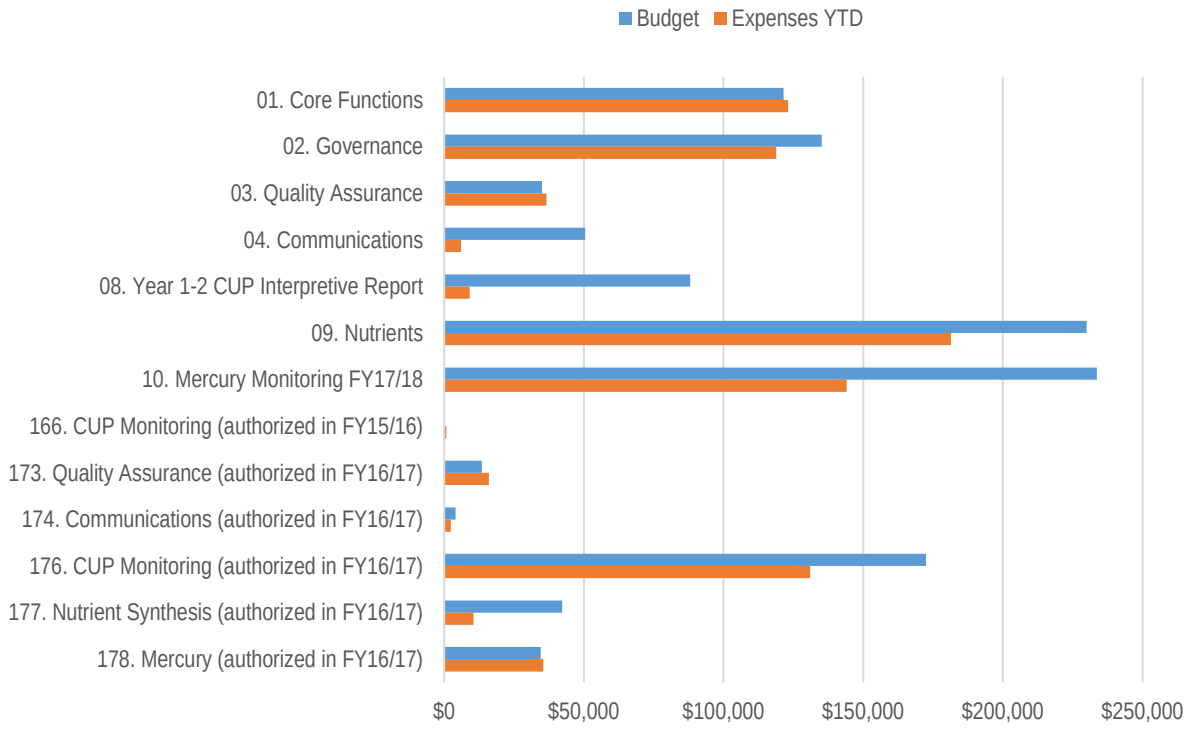

Figure 1 Planned and actual expenses (staff and subcontractors billing) for tasks authorized in the FY17/18 workplan, through 9/30/2018

Discussion of Expenses for Tasks Authorized in the FY17/18 Workplan

A number of the tasks in the FY17/18 workplan are complete and these budget lines are closed to further billing. On some occasions, actual expenses were slightly higher than planned. Other tasks were completed under budget. Table 5 shows a list of completed tasks and subtasks, and the deficit or surplus for each. *Overall, there is a net surplus. Closed tasks were completed $37,743 under budget.*

Much of this savings was in *Task 177C, Nutrients Statistical Analysis*, where we received a substantial in-kind contribution by Dr. Marcus Beck, formerly at USEPA and now at SCCWRP. Dr. Beck analyzed Delta nutrients data and published a journal article in 2018.[1] Only a handful of ASC hours were needed for coordination and to review drafts of manuscript.

[1] Beck, Marcus W., Thomas W. Jabusch, Philip R. Trowbridge, and David B. Senn. "Four Decades of Water Quality Change in the Upper San Francisco Estuary." *Estuarine, Coastal and Shelf Science* 212 (November 2018): 11–22. https://doi.org/10.1016/j.ecss.2018.06.021.

Surplus funds from completed tasks can be unencumbered and transferred to the Reserve Fund at the discretion of the Steering Committee. Here is a draft motion which a Finance Committee member may make at the next SC meeting.

Draft Motion:

Unencumber $37,743, the surplus from completed tasks in the FY17/18 workplan and transfer these funds to the Undesignated Reserve Fund.

We plan to continue tracking monitoring projects and special studies for which the work is not complete or there are invoices to pay that we have not yet received. Here is a list of subtasks which are not complete, and which billing can be expected.

Table 5. (a) Closed tasks and balance remaining at end of the fiscal year.

Task	Planned expense	Actual expense	Net
01. Core Functions	$121,500	$123,055	-$1,555
A. Program Planning	$67,500	$68,813	-$1,313
B. Contract and Financial Management	$54,000	$54,242	-$242
02. Governance	$125,104	$118,880	$6,224
A. SC meetings	$44,734	$41,310	$3,424
B. TAC meetings	$57,870	$55,421	$2,449
C. Technical Subcommittees	$22,500	$22,149	$351
03. Quality Assurance	$35,000	$36,662	-$1,662
A. Quality Assurance System	$15,000	$17,250	-$2,250
B. Technical Oversight and Coordination	$15,000	$14,755	$245
D. Data Management Subcommittee	$5,000	$4,657	$343
04. Communications	$10,500	$4,878	$5,622
A. Stakeholder Board Meetings	$5,500	$3,370	$2,130
C. Data Assessment Framework Workshop	$5,000	$1,508	$3,492
09. Nutrients	$35,000	$32,284	$2,716
B. Nutrient Data Synthesis and Reporting	$20,000	$19,816	$184
C. Chlorophyll Sensor Intercalibration	$15,000	$12,468	$2,532
166. CUP Monitoring (authorized in FY15/16)	-$1,745	$812	-$2,557
E. Reporting	-$1,745	$812	-$2,557
173. Quality Assurance (authorized in FY16/17)	$13,434	$15,975	-$2,541
A. Quality Assurance System	$6,311	$7,868	-$1,557
B. Technical Oversight	$7,123	$8,106	-$983
174. Communications (authorized in FY16/17)	$4,084	$2,412	$1,672
A. Factsheet	$4,084	$2,412	$1,672
176. CUP Monitoring (authorized in FY16/17)	$18,399	$19,355	-$956
D. Data Management	$14,651	$17,264	-$2,613
E. Reporting	$3,748	$2,091	$1,657
177. Nutrient Synthesis (authorized in FY16/17)	$42,237	$10,494	$31,743
A. Nutrient Synthesis	$8,670	$5,534	$3,136
B. Nutrient Modeling	-$1,034	$3,658	-$4,692
C. Nutrient Statistical Analyses	$34,601	$1,302	$33,299
178. Mercury (authorized in FY16/17)	$34,557	$35,521	-$964
A. Data Collection	$19,224	$19,224	$0
B. Data Management	$10,546	$10,286	$260
D. Reporting	$4,787	$6,011	-$1,224
Grand Total	$438,070	$400,327	$37,743

(b) Tasks that are uncompleted and will remain open to continued billing.

Task, Subtask	Expected Completion Date	Planned expense	Actual YTD expense	Budget Remaining
02. Governance				
D. Science Advisors	Jun 2019	$10,000	$0	$10,000
04. Communications				
B. Pulse of the Delta Draft	Jun 2019	$40,000	$1,178	$38,822
08. Year 1-2 CUP Interpretive Report				
A. Report (subcontract)	Jun 2019	$80,000	$3,045	$76,955
B. Contract Mgmt (Pesticides Report)	Jun 2019	$8,000	$6,045	$1,955
09. Nutrients				
A. Cross-Delta Monitoring Using High Frequency Tools	Jun 2020	$195,000	$149,072	$45,928
10. Mercury Monitoring FY17/18				
A Data Collection and Analysis*	Jun 2018*	$209,016	$131,209	$77,807
B. RMP Data Management	Dec 2018	$19,545	$10,932	$8,613
C. Technical Oversight	Feb 2019	$5,000	$1,855	$3,145
176. CUP Monitoring (authorized in FY16/17)				
B. Pesticide Laboratory Work*	Jun 2018*	$154,029	$111,663	$42,366
Total		$720,590	$414,999	$305,591

* Sampling and lab analysis is complete but ASC has not yet been invoiced by the subcontractors.

Undesignated Reserve Fund

The current balance of undesignated funds is $133,579.

Table 6 shows a running list of deposits and withdrawals into the Undesignated Reserve Fund.

Table 6 Delta RMP Undesignated Reserve Fund ledger.

Budget Year	Deposit or Withdrawal	Authorized by	Date	Amount	Running Total	Comment
FY14/15	Deposit	Steering Committee	6/16/2015	$41,000	$41,000	Release funds allocated for CUP monitoring in FY14/15 budget in order to re-allocate these funds into the FY1516 budget for CUP monitoring.
FY15/16	Withdrawal	Steering Committee	6/16/2015	($41,000)	--	Released funds allocated for CUP monitoring in FY14/15 budget in order to re-allocate these funds into the FY1516 budget for CUP monitoring.
FY14/15	Deposit		10/15/2015	$51,903	$51,903	Extra revenue received in FY14/15. Actual revenue minus budgeted expenses for FY14/15.
FY15/16	Withdrawal	Steering Committee	4/25/2016	($20,000)	$31,903	Allocate funding to FY15/16 for possible pathogen trigger study (TBD).
FY15/16	Deposit	Steering Committee	4/25/2016	$100,000	$131,903	SC directed that SFCWA funding of $100,000 (contribution for FY15/16) be transferred to reserve.
FY 16/17	Withdrawal	Steering Committee	4/25/2016	($100,000)	$31,903	SC directed that $100,000 be withdrawn from the reserve to be reallocated as revenue for FY16/17. SFCWA contribution in March 2017 ($100K) will be allocated to FY17/18 revenue.
FY15/16	Deposit	Steering Committee	7/20/2016	$84,444	$116,347	SC approved that $84,444 be transferred from FY15/16 revenue to the reserve as undesignated funds.
FY16/17	Withdrawal	Steering Committee	10/18/2016	($10,000)	$106,347	SC approved up to $10,000 for coordinating and drafting a response to the External Panel Review.
FY16/17	Withdrawal	Finance Committee	5/23/2017	($7,500)	$98,847	Finance Subcommittee approved transfer of funds to cover final phase of External Review.
FY14/15	Deposit	Steering Committee	7/28/2017	$725	$99,572	SC directed that $725 surplus from FY14/15 budget be transferred to the reserve as undesignated funds.
FY17/18	Deposit	Steering Committee	3/2/2018	$34,007	$133,579	SC voted to unencumber the $25,910 FY15/16 surplus and the $8,097 FY16/17 surplus and transfer the amount of $34,007 to the Reserve Fund
TOTAL				**$133,579**		**Undesignated funds balance**

Expected Revenue in FY18/19

In the FY18/19 workplan, we reported an expected revenue for the fiscal year of **$900,256**. Since that time, we have received word of three new participants:

(1) The California Department of Water Resources is expected to contribute $200,000. Their contribution is required under three separate permits issued by the Central Valley Regional Water Quality Control Board, covering projects related to dam operations and habitat restoration.

(2) The California Department of Transportation (CalTrans) stormwater management program is expected to contribute $80,000.

(3) Finally, the US Army Corps of Engineers, which dredges channels for navigation in the Delta, has been required to contribute $50,000. However, they will make their contribution to the program by directly funding work by the USGS. For administrative reasons, it is much easier for the Corps to transfer funds to another federal agency rather than paying a private contractor, which requires authorization by the US Congress. Their contribution will offset program expenses for pesticides monitoring. Because this cash will never "hit our books," we are tracking this as an in-kind contribution.

Note: As as a result of this new $50,000 in-kind contribution from the Army Corps of Engineers, and due to federal contracting rules, the USGS will be end up making an in-kind contribution that is $5,644 lower than we had originally anticipated.

The Joint Funding Agreement between ASC and the USGS for pesticides monitoring includes an in-kind contribution on the part of USGS, in the form of a 10% federal cost share on labor and travel expenses. However, when USGS receives funding from another federal agency, there is no cost share available. In addition, the overhead rate on the Corps funds is a fraction of a percent higher than for USGS' funding agreement with ASC. As a result of these changes, the USGS Pesticide Fate Research Group (PFRG) gave us a revised budget for FY18/19 pesticide sampling. The total project cost is the same, however, the USGS cost share is lower than before:

	Old cost estimate	**Revised amount in joint funding agreement**
Delta RMP funding (via ASC)	$199,873	$155,517
USGS cost share	*$19,344*	*$13,700*
Army Corps contribution	-	$50,000
Total Project Cost	**$219,217**	**$219,217**

As noted, the total cost of the pesticides monitoring project is the same. The revised funding arrangement will provide the exact same amount of personnel hours, supplies, analytical costs, etc. as were originally planned. However, while the Delta RMP is **gaining** a $50,000 in-kind

contribution from the Corps, in a sense we are **losing** an anticipated $5,644 in-kind contribution from the USGS. This can be thought of as a "cost of doing business." We still benefit greatly from this new indirect contribution to the program by the Army Corps.

Based on the two new direct contributors to the program, we are revising the revenue forecast for FY18/19 upward by $280,000 to **$1,180,256.** Because this amount is greater than our planned expense, we have additional funds that can be allocated for other purposes at the direction of the Steering Committee or eventually added to the Undesignated Reserve Fund.

Expected Revenue	$1,180,256
Planned expenses	–$1,053,888
Net	**$126,368**

Revenue Collected to Date

ASC sent invoices to Delta RMP participants in May 2018, with payments expected by July 30, 2018. To date, we have received 44 of 52 expected payments, for a total of **$727,056**, or **61%** of expected revenue for FY18/19. Regional Board staff are in the process of contacting agencies who have not yet paid.

Expenses in the first quarter of FY18/19

For tasks authorized under the FY18/19 Workplan, expenses in Q1 are tracking roughly in line with expectations. A summary of expenses by task is shown in Table 7. Additional details are shown in Table 9 at the end of this memo.

We expect burn rates on several tasks to be higher in the next quarter as we begin receiving monitoring data from labs and cooperators. In addition, ASC will be onboarding two new environmental scientists in coming weeks, both of whom are expected to contribute to Delta RMP projects.

Table 7. Planned and actual expenses for tasks authorized in the FY18/19 workplan, through the end of the first quarter (July, Aug, Sept 2018).

Task	Planned expense	Actual YTD Expense	Percent spent
01. Core Functions*	$124,400	$29,488	24%
02. Governance	$134,800	$20,025	15%
03. Quality Assurance	$32,500	$11,160	34%
04. Nutrients Special Studies FY18/19	$228,400	$2,034	1%
05. Mercury Monitoring FY18/19	$277,210	$787	0.3%
06. Pesticides Monitoring FY18/19	$211,578	$0	0%
07. CEC Monitoring Plan FY18/19	$45,000	$250	1%
Total	**$1,053,888**	**$63,743**	**6%**

Amendments to FY18/19 Planned Expenses

As of October 10, 2018, a new budget line will be added under *Task 1, Core Functions*, as *Subtask C, Proposal Writing*, adding a planned expense of $8,306. The Steering Committee co-chairs requested that ASC consider submitting a proposal to the state for Prop 1 grant funding on behalf of the Delta RMP. Proposals are due October 26, 2018. ASC staff have already begun working closely with the CEC Subcommittee on the planned proposal, even though the existing workplan does not include any budget for grant writing, and is expected that this will be a significant effort.

On October 10, 2018, the Finance Committee approved $8,306 in new expenses to cover ASC labor expenses for planning, writing, and submitting the grant proposal. (According to the Delta RMP Charter, the Finance Committee may authorize expenses up to $25,000). Planned expenses for proposal writing are for ASC labor only, and do not include any direct expenses or subcontracts. The budget for this subtask is shown here:

Table 8. Budget detail for new budget line, Task 1, Core Functions, Subtask C, Proposal Writing, approved by the Finance Committee on October 10, 2018.

Staff member	Description of tasks	Planned Hours	Planned Billing
Matthew Heberger, PE	Project management, writing, editing	24	$2,996
Nina Buzby	Research, writing	40	$3,098
Rebecca Sutton, PhD	Principal investigator, science strategy	8	$1,368
Jay Davis, PhD	Oversight, review	4	$844
Total		**76**	**$8,306**

There were no expenses to this subtask in the first quarter of FY18/19. Therefore, no expenses for this subtask appear in this memo. We will begin reporting these expenses in the next quarter's finance report.

Invoices

Please follow this link to download the invoices covered by this memo:

https://drive.google.com/drive/folders/0B8LZA-e4CFNlUVN2SjJCNGFnbTg?usp=sharing

Appendix – Detailed Expense Tables

See the following pages for detailed tables of expenses by task:

Table 9 Planned and actual expenses for tasks authorized in the Delta RMP FY17/18 Workplan, by task and subtask, with details on expenses in the last quarter.

Table 10. Planned and actual expenses for tasks authorized in the Delta RMP FY18/19 Workplan, by task and subtask, with details on expenses in the last quarter.

Table 9. Planned and actual expenses for tasks authorized in the Delta RMP FY17/18 Workplan, by task and subtask, with details on expenses in the last quarter.

Task	Subtask	Expected Completion Date	Budget	New expenses in this report	Total expenses to date	Budgeted funds remaining	Percent of budget spent	Staff and subcontractors billing	Description and Notes
01. Core Functions	A. Program Planning		$67,500	$1,537	$68,813	($1,313)	101.9%	Davis, Jay (2 hrs) Heberger, Matthew (3 hrs) Salomon, Micha (2.5 hrs) Sutton, Rebecca (2 hrs) Trowbridge, Philip (1.25 hrs)	**Outputs:** Internal coordination, staff meetings, labor planning, oversight and project management. Tracking and updating stoplight reports of action items and deliverables. Coordinated letter of support for USGS Prop 1 mercury proposal. Developed GIS data and maps to support pesticide planning. Senior scientist Becky Sutton reviewed CEC strategy implementation scenarios and provided technical advice to Delta RMP subgroup. **Closed to further billing.**
	B. Contract and Financial Management		$54,000	$3,803	$54,242	($242)	100%	Heberger, Matthew (8.5 hrs) Leung, Frank (5 hrs) Lofthouse, Meredith (24 hrs)	**Outputs:** Internal accounting; subcontract management; checked and approved internal and external invoices; tracked expenses by task. Preparation for finance subcommittee on July 2, 2018. Followed up on invoices and contracts for Delta RMP participants. **Deliverables completed:** Quarterly finance memo for period through 5/31/2018. **Closed to further billing.**
02. Governance	A. SC meetings		$44,734	$800	$41,310	$3,424	92%	Daphne Orzalli Invoice: $800 applied to SC meetings.	Paid invoice for meeting note-taker. **Closed to further billing.**
	B. TAC meetings		$57,870	$11,796	$55,421	$2,449	96%	Heberger, Matthew (59.5 hrs) Employee reimbursement for mileage to June 12 TAC meeting in Rancho Cordova: $94.88 Orzalli Invoice: $1,200 applied to TAC meetings McCord Invoices paid: $2,520 $1,080	**Outputs:** Preparation and participation in the TAC meeting held on Apr 23, 2018. Distributed agenda and meeting summaries, coordinated with co-chairs and facilitator. Follow up on action items. Updated action items and deliverables tracking sheets. Set dates and locations for next meeting and sent invitations. Paid invoices to TAC chair and note-taker. **Deliverables**: TAC meeting held on Apr 23, 2018. Meeting agenda package and draft summary. **Closed to further billing.**
	C. Technical Subcommittees		$22,500	$2,030	$22,149	$351	98%	Heberger, Matthew (17.5 hrs)	**Outputs:** Prepared agendas and materials for Pesticides Subcommittee meetings and responded to comments from committee members. **Deliverables completed:** None. Preparation for 3 meetings held in the fall. **Closed to further billing.**
	D. Science Advisors	2019-06-30	$10,000	$0	$0	$10,000	0%		Earmarked for paying honoraria to our science advisors. Delayed in FY17/18 due to the lengthy nomination and selection process.
03. Quality Assurance	A. Quality Assurance System		$15,000	$0	$17,250	($2,250)	115%		**Closed to further billing.**
	B. Technical Oversight and Coordination		$15,000	$0	$14,755	$245	98%		**Closed to further billing.**
	D. Data Management Subcommittee		$5,000	$2,023	$4,657	$343	93%	Franz, Amy (5 hrs) Heberger, Matthew (4 hrs) Yee, Donald (6 hrs)	**Outputs:** Participated in Data Management Subcommittee on June 26 and drafted summary. Revisions to Data Management and Quality Assurance Standard Operating Procedures document. Tracking and follow up on action items from meetings. **Deliverables completed:** Summary of June 26 Data Management Subcommittee Meeting. **Closed to further billing.**

Task	Subtask	Expected Completion Date	Budget	New expenses in this report	Total expenses to date	Budgeted funds remaining	Percent of budget spent	Staff and subcontractors billing	Description and Notes
04. Communications	A. Stakeholder Board Meetings		$5,500	$3,370	$3,370	$2,130	61%	Askevold, Ruth (8 hrs) Heberger, Matthew (18 hrs)	**Outputs**: Prepared poster for and attended the Bay Delta Science Conference, an important outreach opportunity for the program. **Deliverables**: 3' x 4' poster summarizing the program's accomplishments over its 4-year existence. **Closed to further billing.**
	B. Pulse of the Delta Draft	2019-06-30	$40,000	$0	$1,178	$38,822	3%		Most labor deferred to FY18/19.
	C. Data Assessment Framework Workshop		$5,000	$0	$1,508	$3,492	30%	None this period.	Note: This new budget line created at the request of the Coordinating Committee in Nov 2017 to enable ASC to help plan and coordinate a "Data Assessment Framework Workshop." However, the State Board withdrew their offer of support, leaving this task unable to be completed. **Closed to further billing.**
08. Year 1-2 CUP Interpretive Report	A. Report (subcontract)	2019-06-30	$80,000	$0	$3,045	$76,955	4%	None this period.	Earmarked to pay the consultant (Deltares) for the Pesticides Interpretive Report. Some spending occurred before decision was made to outsource.
	B. Contract Manageemement (Pesticides Report)	2019-06-30	$8,000	$1,231	$6,045	$1,955	76%	Heberger, Matthew (2 hours)	**Outputs:** Put in place contract with Deltares. Held kickoff meeting with project PI. Answered their questions via email. **Deliverables completed:** Signed contract with Deltares. Kickoff meeting with contractor.
09. Nutrients	A. Cross-Delta Monitoring Using High Frequency Tools	2020-06-30	$195,000	$81,469	$149,072	$45,928	76%	USGS Invoice for $81,469	**Outputs:** USGS completed two high-frequency cruises on May 15-17, 2018 and July 24-26, 2018. **Deliverables completed:** None.
	B. Nutrient Data Synthesis and Reporting		$20,000	$0	$19,816	$184	99%		**Closed to further billing.**
	C. Chlorophyll Sensor Intercalibration, Phase 1		$15,000	$0	$12,468	$2,532	83%		**Closed to further billing.**
10. Mercury Monitoring FY17/18	A Data Collection and Analysis	2018-06-30	$209,016	$63,692	$131,209	$77,807	63%	Moss Landing Marine Laboratory Invoice: $63,692	Earmarked for paying subcontract with Moss Landing Marine Laboratory (MLML).
	B. RMP Data Management	2018-12-31	$19,545	$4,210	$10,932	$8,613	56%	Franz, Amy (10.75 hrs) Ross, John (6 hrs) Weaver, Michael (11 hrs) Yee, Donald (7 hrs)	**Outputs:** QA Review FY 17-18 Fish Mercury data; Data management organization and project management; reviewed requirements for MLML to provide collection information; conversation with lab staff re: colleciton info; revised custom templates for MLML field collection info; loaded data Submittal to preliminary database. **Deliverables**: None this reporting period. Plan to complete data management and QA of mercury data by Dec 2018.
	C. Technical Oversight	2019-02-28	$5,000	$422	$1,855	$3,145	37%	Davis, Jay (2 hrs)	**Outputs:** Lead scientist reviewed data, corresponded with lab director. **Deliverables:** None. Plan draft mercury data report in Dec 2018, final in March 2019. Remaining hours for the principal investigator to draft and oversee production of the data report.
166. CUP Monitoring (authorized in FY15/16)	E. Reporting		($1,745)	$0	$812	($2,557)			**Closed to further billing.**
173. Quality Assurance (authorized in FY16/17)	A. Quality Assurance System		$6,311	$0	$7,868	($1,557)	125%		**Closed to further billing.**

Task	Subtask	Expected Completion Date	Budget	New expenses in this report	Total expenses to date	Budgeted funds remaining	Percent of budget spent	Staff and subcontractors billing	Description and Notes
	B. Technical Oversight		$7,123	$0	$8,106	($983)	114%		**Closed**
174. Communications (authorized in FY16/17)	A. Factsheet		$4,084	$0	$2,412	$1,672	59%		**Closed**
176. CUP Monitoring (authorized in FY16/17)	B. Pesticide Laboratory Work	2018-06-30	$154,029	$0	$111,663	$42,366	72%		Earmarked for paying subcontractor (USGS). Still expecting invoices; expect subcontractor to bill for 100% of contract amount, expending this budget line 100%.
	D. Data Management		$14,651	$529	$17,264	($2,613)		Franz, Amy (0.5 hr) Weaver, Michael (5 hrs)	**Outputs:** Final data management and QA steps to finalize data for publication. Amended some QA flags following comments by Technical Advisory Committee member. **Deliverables completed:** Electronic data and QA memo distributed to TAC and SC. **Closed to further billing.**
	E. Reporting		$3,748	($547)	$2,091	$1,657	56%	**Corrections for previous incorrect billing:** Franz, Amy (-3 hr) Ross, John (-2 hr) Weaver, Michael (-0.5 hr)	**Closed to further billing.**
177. Nutrient Synthesis (authorized in FY16/17)	A. Nutrient Synthesis		$8,670	$0	$5,534	$3,136	64%		**Closed to further billing.**
	B. Nutrient Modeling		($1,034)	$0	$3,658	($4,692)			**Closed to further billing.**
	C. Nutrient Statistical Analyses		$34,601	$0	$1,302	$33,299	4%		**Closed.** **Note:** Most work done as an in-kind contribution by Dr. Marcus Beck, formerly at USEPA and now at SCCWRP. ASC hours have been for coordination and review of the draft manuscript. This allowed for a significant cost savings to the program.
178. Mercury (authorized in FY16/17)	A. Data Collection		$19,224	$0	$19,224	($0)	100%		**Closed to further billing.**
	B. Data Management		$10,546	($48)	$10,286	$260	98%	Correction for previous incorrect billing. Weaver, Michael (-0.5 hr)	**Closed to further billing.**
	D. Reporting		$4,787	$0	$6,011	($1,224)	126%		**Closed to further billing.**
TOTAL			**$1,158,660**	**$176,317**	**$815,326**	**$343,334**	**70%**		

Table 10. Planned and actual expenses for tasks authorized in the Delta RMP FY18/19 Workplan, by task and subtask, with details on expenses in the last quarter.

Task	Subtask	Budget	Expense to date	Percent of budget spent	Task Duration (years)	Staff and subcontractors billing	Description and Notes
01. Core Functions	A. Program Planning	$68,250	$17,256	25%	1.0	Heberger, Matthew (118 hrs) Salomon, Micha (13 hrs) Trowbridge, Philip (2.25 hrs) AMS Invoice, $780 (statistical consultant)	**Outputs**: Internal coordination, staff meetings, labor planning, oversight and project management. Tracking and updating stoplight reports of action items and deliverables. Pesticides project planning, writing sampling and analysis plan, coordinating with statistical consultant, mapping, and analyses. Participated in Draft Delta Science Joint Proposal Solicitation Notice **Deliverables completed:** Updated workplan following SC meeting and addition of pesticides/ planning budgeting for FY18/19. Updated roster in the Charter. Updated Decision Record.
	B. Contract and Financial Management	$56,150	$12,232	22%	1.0	Heberger, Matthew (33.5 hrs) Hunt, Jennifer (7.25 hrs) Lofthouse, Meredith (72.5 hrs)	**Outputs**: Contract negotiations with Caltrans and DWR. Put in place subcontracts for FY18/19 workplan with Orzalli, McCord, USGS, Deltares, AMS, and UC Davis. **Deliverables completed**: Finance subcommittee meeting on July 2, 2018.
02. Governance	A. SC meetings	$38,400	$5,087	13%	1.0	Heberger, Matthew (40 hrs)	**Outputs:** Planned and coordinated 7/17 SC meeting. Held two coordinating Committee meetings. Updated decision record and action items tracking sheets. Held two "new member orientations" for new SC members**.** **Deliverables completed**: Agenda package and meeting summary for SC meeting held on July 17, 2018.
	B. TAC meetings	$59,400	$7,143	12%	1.0	Heberger, Matthew (38 hrs) McCord Environmental Invoice: $2,400	**Outputs:** Planned and coordinated 9/21 TAC meeting. Met with TAC chair and facilitator and Regional Board staff. Prepared materials for agenda package. **Deliverables completed:** Agenda package and meeting summary for TAC meeting held on Sept 21, 2018.

Task	Subtask	Budget	Expense to date	Percent of budget spent	Task Duration (years)	Staff and subcontractors billing	Description and Notes
	C. Technical Subcommittees	$37,000	$7,795	21%	1.0	Heberger, Matthew (40.5 hrs) Trowbridge, Philip (15.5 hrs)	**Outputs**: Planning of and participation in Nutrients subcommittee meeting on 9/18. Planned, facilitated, and wrote summaries for 6 meetings of the pesticides subcommittee and 1 meeting of the Toxicity workgroup. Preparation for and participation in 2 data management subcommittee meetings. **Deliverables completed:** Meeting summaries for pesticides subcommittee meetings on 8/2, 8/22, 8/28, 9/13, 9/20, and 9/25.
03. Quality Assurance	A. Quality Assurance	$17,500	$5,330	30%	1.0	Franz, Amy (16 hrs) Heberger, Matthew (3.5 hrs) Ross, John (14.5 hrs) Yee, Donald (8 hrs)	**Outputs:** Revised the Delta RMP Quality Assurance Program Plan. Reviewed SWAMP QA Officer comments on the Data Management and Quality Assurance SOP. **Deliverables completed:** None this reporting period.
	B. Technical Oversight and Coordination	$15,000	$5,830	39%	1.0	Heberger, Matthew (16 hrs) Weaver, Michael (28 hrs) Yee, Donald (6 hrs)	**Ouputs**: Variety of miscellaneous items related to running a multifaceted monitoring program: Coordinating the QA memo for pesticides data. Clean up of database and update of QA memo and response to reviewers. Meeting with stakeholders re: questions on QA flags. Distributed Data Visualization to Delta RMP SC, TAC, and Pesticides Subcommittee. Coordinating comments to final draft of Mercury data report. Correspondence with Deltares researchers and stakeholders re: pesticides databases. Correspondence with DPR staff on database issues. Internal meeting with QA Officer re:QAPP and Data Management and Quality Assurance SOP revisions.
04. Nutrients Special Studies FY18/19	A. Nutrients Modeling Study	$186,000	$1,160	1%	**2.0**	Trowbridge, Philip (7.25 hrs)	**Outputs**: Meeting with DWR and modelers about converter code. Internal coordination and team meetings.

Task	Subtask	Budget	Expense to date	Percent of budget spent	Task Duration (years)	Staff and subcontractors billing	Description and Notes
	B. Chlorophyll Inter-calibration Study	$42,400	$874	2%	**1.0**	Heberger, Matthew (7 hrs)	**Outputs**: Correspondence with labs re: participating in chl-a study. Phone meeting with research team the chl-a to coordinate field and lab work. Wrote and distributed meeting summary for chl-a meeting; followup on action items for study. Checked in data from sondes and began visualizing. **Deliverables completed:** None to date. However, two successful sensor deployments have been completed.
05. Mercury Monitoring FY18/19	A Data Collection and Analysis	$242,130	$0	0%	1.0		
	B. Mercury Data Management and Quality Assurance	$29,930	$787	3%	**1.75**	Franz, Amy (10 hrs)	**Outputs**: Checked in August data sample collection data; wrote documentation to manage collection data with updated information from MLML. Uploaded field Data for tissue and water upload. **Deliverables completed**: None to date.
	C. Technical Oversight and Coordination	$5,150	$0	0%	**1.75**		
06. Pesticides Monitoring FY18/19	A. Field sample collection and laboratory analysis	$155,517	$0	0%	**1.25**		Sampling to begin Fall/Winter 2018.
	B. Toxicity reporting	$15,063	$0	0%	**1.25**		
	C. Pesticides Data Management and Quality Assurance	$40,998	$0	0%	**1.75**		
07. CEC Monitoring Plan FY18/19	A. Coordination and planning	$22,000	$250	1%	1.0	Heberger, Matthew (2 hrs)	**Outputs:** Project planning and coordination. Phone call with consultants and Regional Board staff. **Deliverables completed**: None to date.
	B. QAPP Amendments	$23,000	$0	0%	1.0		

Task	Subtask	Budget	Expense to date	Percent of budget spent	Task Duration (years)	Staff and subcontractors billing	Description and Notes
Total		**$1,053,888**	**$63,743**	**6%**			

Materials for Agenda Item 6

Delta RMP Deliverables Stoplight Report

Delta RMP Deliverables Scorecard Report

Key to Status Colors:
Green indicates greater than 90 days until the deliverable is due.
Yellow indicates a deliverable due within 90 days.
Red indicates a deliverable that is overdue.

	Project	Primary	Deliverable	Assigned To	Due Date	Status	Comments
1		SC Meetings	Steering Committee Meeting #2 and Summary	Matthew Heberger	10/31/17	Complete	
2		TAC Meetings	TAC Meeting #2 and Summary	Matthew Heberger	11/07/17	Complete	
3		Technical Reports	RFP for Pesticides/Toxicity Interpretive Report	Matthew Heberger	11/15/17	Complete	RFP issued in in spring 2018, proposals due March 16.
4		CUP Monitoring	6. Data Management of FY16/17 CUP Data	Amy Franz	12/31/17	Complete	Electronic data delivered by USGS in October 2017. ASC staff have finalized provisional data upload but data will not be made public until reviewed by TAC and approved by SC.
5		CUP Monitoring	6. Quality Assurance Report for FY16/17 CUP Monitoring	Don Yee	12/31/17	Complete	Final draft submitted by QAO on June 29, 2018. Forwarded to TAC first week of July.
6		Mercury	8. Mercury YR1 report summarizing fish and water analyses	Matthew Heberger	12/31/17	Complete	Draft report distributed to Mercury Subcommittee in December 2017, recommended by the TAC for publication on March 15, 2018, and approved by the SC on July 17, 2017 pending minor proofreading. Update on 9/14/2018: Report finalized and posted to the Delta RMP website by the end of September 2018
7		Science Advisors	Recruit 2-4 science advisors	Matthew Heberger	12/31/17	Complete	CVs have been collected and candidates screened based on qualifications and willingness to volunteer. For discussion by the TAC in spring 2018 then approval by SC.
8		Continued Nutrient Data Analysis and Biennial Reporting	Complete additional statistical analyses and prepare technical report	Philip Trowbridge	12/31/17	Complete	This task was a placeholder for any follow-on analyses after the three synthesis reports were completed. The subcommittee did not authorize any additional statistical analyses so this task no longer relevant.
9		Contract and Financial Management	Quarterly Financial Update #3	Matthew Heberger	01/09/18	Complete	
10		Nutrients Synthesis	7A1.3 Status and Trends Synthesis Report - Prepare synthesis report	Thomas Jabusch	01/31/18	Complete	Draft completed by mid-July. The Nutrient Subcommittee provided 3 rounds of comments before the text was finalized by the end of December. The Steering Committee approved the report in their February meeting.
11		Nutrients Synthesis	7B2.5 Modeling Synthesis Report - Prepare technical report.	Thomas Jabusch	01/31/18	Complete	Draft completed by mid-July. The Nutrient Subcommittee provided 3 rounds of comments before the text was finalized by the end of December. The Steering Committee approved the report in their February meeting.
12		SC Meetings	Steering Committee Meeting #3 and Summary	Matthew Heberger	01/31/18	Complete	

	Project	Primary	Deliverable	Assigned To	Due Date	Status	Comments
13		CUP Monitoring	6. Permit Compliance Data for ILRP	Amy Franz	02/01/18	Complete	Not necessary in FY18, per agreement with ag coalitions
14		CUP Monitoring	6. Annual Monitoring Report for FY16/17 CUP Monitoring	Thomas Jabusch	02/28/18	Complete	The SC voted on 7/28 that this was no longer necessary, and that funds for this task should be reallocated to the Interpretive Report.
15		TAC Meetings	TAC Meeting #3 and Summary	Matthew Heberger	04/15/18	Complete	
16		Contract and Financial Management	Quarterly Financial Update #4	Matthew Heberger	05/15/18	Complete	
17		SC Meetings	Steering Committee Meeting #4 and Summary	Matthew Heberger	05/15/18	Complete	
18		Nutrients Synthesis	7C3.1 Nutrients- Advanced Statistical Modeling	Thomas Jabusch	06/30/18	Complete	Marcus Beck of SCCWRP (formerly USEPA) is preparing this manuscript as an in-kind contribution. The journal article was published on June 25, 2018. Beck, M.W., Jabusch, T.W., Trowbridge, P.R., and Senn, D.B. 2018. Four decades of water quality change in the upper San Francisco Estuary. Estuarine, Coastal and Shelf Science, 212: 11-22. https://doi.org/10.1016/j.ecss.2018.06.021
19		Program Planning	FY18/19 Workplan and Budget	Matthew Heberger	06/30/18	Complete	
20		Continued Nutrient Data Analysis and Biennial Reporting	Prepare, coordinate, and provide technical support to up to 4 nutrient subcommittee meetings	Philip Trowbridge	06/30/18	Complete	Meetings held on 9/29/17, 12/1/17, 1/18/18, 2/15/18. 4 project proposals for FY18/19 were developed.
21		Continued Nutrient Data Analysis and Biennial Reporting	Outline for biennial synthesis report to be completed in FY18/19	Philip Trowbridge	06/30/18	Complete	Proposal prepared for Nutrient Subcommittee. The Subcommittee set this project as a low priority for further action.
22		Chlorophyll Sensor Intercalibration	Prepare, coordinate, and facilitate Phase 1 Technical Team Meetings	Philip Trowbridge	06/30/18	Complete	3 meetings held on 9/28/17 and 12/5/17 and 2/6/18.
23		Chlorophyll Sensor Intercalibration	Develop Phase 2 Project Plan, including study design, logistics, and institutional coordination	Philip Trowbridge	06/30/18	Complete	Proposal for Phase II study prepared and presented to the SC on 5/11/18.
24		SC Meeting #1 (2018-07-17)	Agenda Package		07/07/18	Complete	
25		TAC Meetings	TAC Meeting #4 and Summary	Matthew Heberger	07/31/18	Complete	Meeting held on 6/12/2018. Draft meeting summary circulated to TAC.
26		WY2016 Modeling and Monitoring Synthesis	Progress Report to Nutrient Subcommittee or Delta-Suisun Modeling Team	Matthew Heberger	07/31/18	Complete	Provided progress report to RB5 to give to the STAG. Gave a presentation to the STAG on 9/18/18.
27		Pesticides Subcommittee Meeting #1	Meeting agenda package; meeting summary	Matthew Heberger	08/01/18	Complete	
28		Pesticides Subcommittee Meeting #2	Meeting agenda package; meeting summary	Matthew Heberger	08/28/18	Complete	
29		Pesticides Subcommittee Meeting #3	Meeting agenda package; meeting summary	Matthew Heberger	09/13/18	Complete	
30		Toxicity Work Group Meeting #1	Meeting agenda package; meeting summary	Matthew Heberger	09/13/18	Complete	
31		TAC Meeting #1 (2018-09-21)	Agenda Package		09/14/18	Complete	
32		SC Meeting #1 (2018-07-17)	Meeting Summary		09/28/18	Complete	
33		A. QAPP Revision	Draft revised QAPP to send to signatories	Don Yee	09/28/18		
34		Quality Assurance	Revised QAPP for FY18/19	Matthew Heberger	09/30/18		QAPP revisions will be necessary if SC approves plan for monitoring of pesticides and toxicity. Deadline of 9/30 to coincide with the end of the water year, so monitoring may begin on 10/1.

	Project	Primary	Deliverable	Assigned To	Due Date	Status	Comments
35		Nutrients Subcommittee Meeting #1	Meeting agenda package; meeting summary	Philip Trowbridge	09/30/18	Complete	
36		Chlorophyll Sensor Intercalibration Study	Workgroup Meeting #1, Agenda and Summary	Philip Trowbridge	09/30/18	Complete	
37		TAC Meeting #1 (2018-09-21)	Meeting Summary		10/05/18	Complete	Draft distributed to TAC via email on Oct 3.
38		B. Contract and financial management	Quarterly finance update #1	Matthew Heberger	10/08/18	Complete	
39		SC Meeting #2 (2018-10-29)	Agenda Package		10/14/18	Complete	
40		Mercury Subcommittee Meeting #1	Meeting agenda package; meeting summary	Jay Davis	10/31/18	Complete	
41		CEC Subcommittee Meeting #1	Meeting agenda package; meeting summary	Matthew Heberger	10/31/18	Complete	
42		SC Meeting #3 (2019-02-22)	Agenda Package		11/15/18		
43		Mercury Monitoring	Mercury Data Management	Amy Franz	11/30/18		As of Sept 2018, data has been received from the lab. Data management is not marked as complete until QA is complete and data is uploaded to CEDEN.
44		Mercury Monitoring	Mercury QA Memo	Don Yee	11/30/18		As of Sept 2018, QA is in progress for water, sediment, and fish tissue data.
45		Meeting #2 (2018-10-29)	Summary		12/28/18		
46		Program Planning	Amended Charter (if necessary)	Matthew Heberger	12/31/18	Complete	
47		Program Planning	Amended Communication Plan (if necessary)	Matthew Heberger	12/31/18	Complete	
48		TAC Meeting #2 (Winter 2018)	Agenda Package		12/31/18		
49		Pesticides Subcommittee Meeting #4	Meeting agenda package; meeting summary	Matthew Heberger	12/31/18	Complete	
50		Nutrients Subcommittee Meeting #2	Meeting agenda package; meeting summary	Philip Trowbridge	12/31/18	Complete	
51		Toxicity Work Group Meeting #2	Meeting agenda package; meeting summary	Matthew Heberger	12/31/18		
52		Chlorophyll Sensor Intercalibration Study	Assessment of Chlorophyll Sensor Methods In Use	Philip Trowbridge	12/31/18		USGS will lead this task
53		Chlorophyll Sensor Intercalibration Study	Presentation to WG on Field Intercalibration Exercises	Philip Trowbridge	12/31/18		
54		Chlorophyll Sensor Intercalibration Study	Workgroup Meeting #2, Agenda and Summary	Philip Trowbridge	12/31/18	Complete	
55		WY2016 Modeling and Monitoring Synthesis	Obtain WY2016 Hydrodynamics Model Output	Matthew Heberger	12/31/18		WY2016 hydrodynamics will be developed in DFM by SFEI staff. The STAG/Nutrients Subcmte was briefed of this change on 9/18/18 and agreed.
56		TAC Meeting #2 (Winter 2018)	Meeting Summary		01/15/19		
57		WY2016 Modeling and Monitoring Synthesis	Progress Report to Nutrient Subcommittee or Delta-Suisun Modeling Team	Matthew Heberger	01/31/19		This update should be given at the Delta-Suisun Team Meeting
58		B. Contract and financial management	Quarterly finance update #2	Matthew Heberger	02/01/19		
59		TAC Meeting #3 (Spring 2019)	Agenda Package		02/28/19		

	Project	Primary	Deliverable	Assigned To	Due Date	Status	Comments
60		TAC Meeting #3 (Spring 2019)	Meeting Summary		03/15/19		
61		Meeting #3 (2019-02-22)	Summary		03/29/19		
62		Cross-Delta Monitoring Using High-Frequency Tools	Report from USGS on Cross-Delta High Frequency Monitoring Project	Philip Trowbridge	03/31/19		Will consist of three cruises conducted three times on three successive days in Spring (May 2018), Mid Summer (~mid to late July 2018), and Fall (~late October 2018). The product will be a final technical report. In Sept 2017, USGS met with the Nutrients Subcommittee and finalized the 3 cruise tracks. USGS attempted one cruise afterwards but ran into technical problems. So, the Nutrients Subcommittee decided to postpone the project so all 3 cruises will happen in Water Year 2018, commencing in spring, once flows recede. This delay sets the deadline for the final report as early 2019 as a draft. The final report will include a discussion of how the HF data should be used in the context of other monitoring data.
63		Pesticides Subcommittee Meeting #5	Meeting agenda package; meeting summary	Matthew Heberger	03/31/19		
64		Nutrients Subcommittee Meeting #3	Meeting agenda package; meeting summary	Philip Trowbridge	03/31/19		
65		Mercury Subcommittee Meeting #2	Meeting agenda package; meeting summary	Jay Davis	03/31/19		
66		CEC Subcommittee Meeting #2	Meeting agenda package; meeting summary	Matthew Heberger	03/31/19		
67		Chlorophyll Sensor Intercalibration Study	Report on Laboratory Intercalibration Study	Philip Trowbridge	03/31/19		
68		Chlorophyll Sensor Intercalibration Study	Workgroup Meeting #3, Agenda and Summary	Philip Trowbridge	03/31/19		
69		7.A. CEC Monitoring Coordination and planning	CEC Sampling and Analysis Plan	Matthew Heberger	03/31/19		
70		A. Program planning	Workplan for FY19/20	Matthew Heberger	05/01/19		
71		B. Contract and financial management	Quarterly finance update #3	Matthew Heberger	05/01/19		
72		SC Meeting #4 (May 2019)	Agenda Package		05/01/19		
73		7.B. QAPP Amendments to cover CEC Monitoring	Amended QAPP including complete description of CEC monitoring	Matthew Heberger	05/31/19		
74		Meeting #4 (May 2019)	Summary		06/28/19		
75		Communications	"Pulse of the Delta" Draft	Matthew Heberger	06/30/19		As of April 2018, the Steering Committee has not yet scheduled a discussion of this or approved the outline, giving ASC the effective “notice to proceed.” To be drafted in FY18/19.
76		B. Contract and financial management	Quarterly finance update #4	Matthew Heberger	06/30/19		
77		TAC Meeting #4 (Summer 2019)	Agenda Package		06/30/19		
78		Pesticides Subcommittee Meeting #6	Meeting agenda package; meeting summary	Matthew Heberger	06/30/19		
79		Nutrients Subcommittee Meeting #4	Meeting agenda package; meeting summary	Philip Trowbridge	06/30/19		

	Project	Primary	Deliverable	Assigned To	Due Date	Status	Comments
80		Chlorophyll Sensor Intercalibration Study	Summary Report with Recommendations for Next Steps	Philip Trowbridge	06/30/19		
81		Chlorophyll Sensor Intercalibration Study	Workgroup Meeting #4, Agenda and Summary	Philip Trowbridge	06/30/19		
82		TAC Meeting #4 (Summer 2019)	Meeting Summary		07/15/19		
83		WY2016 Modeling and Monitoring Synthesis	Progress Report to Nutrient Subcommittee or Delta-Suisun Modeling Team	Matthew Heberger	07/31/19		This update should be given at the Delta-Suisun Team Meeting
84		5.B. Mercury Data Management and Quality Assurance	Mercury Fish and Water QA Summary Technical Memo	Don Yee	10/31/19		
85		WY2016 Modeling and Monitoring Synthesis	Develop Converter Code	Matthew Heberger	12/31/19		Code will be developed during 2019. Code could not be developed in 2018 without delaying the project. The STAG/Nutrients Subcmte was briefed of this change on 9/18/18 and agreed.
86		5.A. Mercury Data collection and analysis	Year 3 Mercury Data Report	Jay Davis	12/31/19		
87		6.A. Field sample collection and laboratory analysis	Pesticides Chemistry Lab Report	Jim Orlando	12/31/19		Report to the Delta RMP; not a formal USGS Data Series Report.
88		6.B. Toxicity reporting	Toxicity Lab Reporting	Marie Stillway	12/31/19		ASC has contracted with AHPL to produce this report, as it is NOT covered under the contract with SWAMP. In lieu of a formal report, the lab manager will provide provisional data and information on the labs internal processes and controls, including: A) SWAMP Toxicity Transformers (no charge); B) Bench Sheet Copies; C) Reference Toxicant Control Charts; D) Corrective Actions Table.
89		6.C. Pesticides Data Management and Quality Assurance	Pesticides chemistry QA Summary and Technical Memo	Don Yee	12/31/19		
90		WY2016 Modeling and Monitoring Synthesis	Progress Report to Nutrient Subcommittee or Delta-Suisun Modeling Team	Matthew Heberger	01/31/20		This update should be given at the Delta-Suisun Team Meeting
91		WY2016 Modeling and Monitoring Synthesis	Draft Report for Delta RMP Committee Review	Matthew Heberger	03/31/20		
92		WY2016 Modeling and Monitoring Synthesis	Final Report	Matthew Heberger	06/30/20		

Delta RMP Action Items Stoplight Report

Key to Status Colors:
Green indicates greater than 90 days until the deliverable is due.
Yellow indicates a deliverable is due within 90 days.
Red indicates a deliverable that is overdue.

	Primary	Meeting Date	Deliverable	Assigned To	Due Date	Status	Comments
1	SC Action Items 10/24/2017	10/24/17	Finalize the 7/28/17 Meeting Summary and post to the	Matthew Heberger	11/30/17	Complete	
2	SC Action Items 10/24/2017	10/24/17	Email the Science Advisor Form to Steering Committee members, as well as a reminder to TAC members to continue to submit additional nominations by the end of the year	Matthew Heberger	11/30/17	Complete	
3	SC Action Items 10/24/2017	10/24/17	Forward the Delta Science Plan questionnaire to Steering Committee members in advance of the January 23, 2018 meeting	Matthew Heberger	01/15/18	Complete	Included in agenda package.
4	SC Action Items 10/24/2017	10/24/17	Tom Grovhoug will work with Linda Dorn and Greg Gearheart to fund and host a half-day workshop to further develop the Assessment Framework.	Tom Grovhaug	02/28/18	*Complete*	Initial planning meetings have taken place. Coordinating Committee directed ASC to help facilitate and to budget up to $5K for this task. Subsequently, State Board staff backed off their commitment to fund this workshop and asked that if it continues to be an SC priority, that they should fund it.
5	SC Action Items 10/24/2017	10/24/17	Revised decision grid and trial run results will be reviewed at the December TAC meeting	Brian Lauerson	12/12/17	Complete	
6	SC Action Items 10/24/2017	10/24/17	Decision grid results should be presented to the SC in its January 2018 meeting	Brian Lauerson	01/23/17	Complete	Pre-proposal for CECs is on the agenda.
7	SC Action Items 10/24/2017	10/24/17	Greg Gearheart and Adam Laputz will work on the clarifying language on Conflict of Interest for inclusion in the Charter, consulting State Board legal counsel as needed.	Adam Laputz	12/31/17	Complete	Email reminder sent March 2018. Email reminder sent August 2018. October 2018, this item was cancelled, as Greg and Adam no longer felt it was necessary.
8	SC Action Items 10/24/2017	10/24/17	A workgroup will be formed to support Greg's staff to draft data visualization products for TAC and SC review	Matthew Heberger	12/31/17	Complete	Team participants include: Selina Cole, Melissa Turner, Vyomini Upadhyay, Stephen McCord, and Matthew Heberger.
9	TAC Action Items from 12/12/2017	12/12/17	Data Assessment Framework Workshop: Greg Gearheart will have OIMA staff draft a white paper. The ad hoc workgroup will hold a conference call in mid-January and the item will be included in the January 23, 2018 Steering Committee agenda, with a workshop tentatively planned for February.	Greg Gearheart	01/23/18	Complete	Update: Some initial planning had been done, but OIMA has informed us that they are no longer willing to pay for this workshop. To be discussed by the SC to determine whether this is still a priority, and whether they wish to allocate funding to cover it. Update Sept. 2108: Cancelling this item at the direction of the Coordinating Committee. It is felt that the new Data Management Subcommittee is handling these issues and will make recommendations.
10	TAC Action Items from 12/12/2017	12/12/17	Schedule a Pesticides Subcommittee meeting in the first half of January	Matthew Heberger	12/15/17	Complete	
11	TAC Action Items from 12/12/2017	12/12/17	Edit the proposed changes to Delta RMP Assessment Questions for Nutrients memo as described above	Philip Trowbridge	12/31/17	Complete	
12	TAC Action Items from 12/12/2017	12/12/17	Re: Science Advisors, Screen CVs based on the above criteria and bring results back to the March 15, 2018 TAC Meeting; (2) draft the job description, including $2K/year stipend, one in-person meeting (with expenses paid), review reports, and provide guidance on monitoring designs.	Matthew Heberger	02/15/18	Complete	

	Primary	Meeting Date	Deliverable	Assigned To	Due Date	Status	Comments
13	TAC Action Items from 12/12/2017	12/12/17	Summarize the Technical Advisory Committee's understanding of the use of Reporting Limits and Method Detection Limits for inclusion in the Reporting Section of the QAPP	Matthew Heberger	07/31/18	Complete	To be done for the FY18/19 QAPP
14	SC Action Item 2/5/2018	02/05/18	Circulate the revised RFP document to SC members and asked them to share it widely with their professional networks.	Matthew Heberger	02/28/18	Complete	
15	SC Action Items 3/2/2018	03/02/18	Finalize the October 24, 2017 Joint Meeting Summary and post to the website.	Matthew Heberger	03/31/18	Complete	
16	SC Action Items 3/2/2018	03/02/18	Schedule additional 1 to 1.5 hr. Steering Committee conference call as needed to cover agenda items that we did not have time to cover at the March SC meeting	Matthew Heberger	04/30/18	Complete	
17	SC Action Items 3/2/2018	03/02/18	Form a data management subcommittee	Matthew Heberger	04/30/18	Complete	
18	SC Action Items 3/2/2018	03/02/18	Adam Laputz, Greg Gearheart, Sam Safi, and Debbie Webster will meet and compile feedback from committee members on the draft Delta Science Plan and forward to Yumiko Henneberry.	Adam Laputz	04/30/18	Complete	Email reminder sent on 4/27. From Sam Safi: "Regional San staff attended the April 6 Delta Science Plan amendment workshop. Our overall feedback at the workshop was that Delta Science Program should collaborate with Regional Board and Delta RMP. There will be a public comment period when the draft plan along with public feedback released in summer 2018. So I believe the opportunity is still there."
19	SC Action Items 3/2/2018	03/02/18	Update the Monitoring Design to include recommended changes to the Nutrients Assessment Questions approved by the Steering Committee	Matthew Heberger	05/30/18	Complete	
20	SC Action Items 3/2/2018	03/02/18	The SC requested that ASC and the Finance Subcommittee begin considering options for the upcoming fiscal year's work plan that are in line with possible funding scenarios	Matthew Heberger	04/30/18	Complete	This is a regular part of our revenue forecasting and budgeting process.
21	SC Action Items 3/2/2018	03/02/18	The Finance Subcommittee was asked to develop some "out of the box" options for addressing the need to maintain purchasing power but the unwillingness of participants to vote for a fee increase at their next meeting	Finance Subcommittee	05/31/18	Complete	Discussed the week of April 23, 2018.
22	SC Action Items 3/2/2018	03/02/18	Schedule a conference call for committee discussion of the fee increase issue	Matthew Heberger	04/30/18	Complete	To discuss during the next regularly scheduled Finance Subcommittee meeting.
23	SC Action Items 3/2/2018	03/02/18	RMP should look into whether SCCWRP model is feasible for the Delta RMP contracting process (e.g., requiring labs to conduct inter-laboratory comparison testing so that they can participate in sampling for the program).	Adam Laputz	06/01/18	Complete	Discussed at a meeting of the Toxicity Work Group on May 14, 2018. We concluded it is not feasible because (a) SCWRPP awards millions in contracts which gives them leverage that we do not have (b) at present we are locked into a single-source contract.
24	TAC Action Items from 3/15/2018	03/15/18	Set April 23, 2018 and September 21, 2018 meeting locations and announce to TAC	Matthew Heberger	04/15/18	Complete	
25	TAC Action Items from 3/15/2018	03/15/18	Revise the December 12, 2017 TAC Summary to clarify the edit which was made to the Current Use Pesticides Data Report.	Matthew Heberger	04/15/18	Complete	
26	TAC Action Items from 3/15/2018	03/15/18	Revise the decision grid survey as appropriate for ranking monitoring propsals and forward a link for completing the surveys to TAC members for each proposal to be rated.	Matthew Heberger	03/21/18	Complete	
27	TAC Action Items from 3/15/2018	03/15/18	Develop the modified versions of the proposed pesticides moniotring designs and have them ready for review by the Pesticides Subcommittee	Matthew Heberger	03/21/18	Complete	
28	TAC Action Items from 3/15/2018	03/15/18	Set the next Pesticide Subcommittee meeting date based on the Doodle Poll, closing March 16, 2018, and notify committee members of the meeting date.	Matthew Heberger	03/21/18	Complete	
29	TAC Action Items from 3/15/2018	03/15/18	Reconfirm their interest and availability of our science advisor nominees, and determine whether an honorarium can be paid to each; federal employees are typically not eligible to receive honoraria	Matthew Heberger	04/30/18	Complete	Emails sent the first week of May, awaiting confirmation from some.

	Primary	Meeting Date	Deliverable	Assigned To	Due Date	Status	Comments
30	TAC Action Items from 3/15/2018	03/15/18	Look into revising the Draft Mercury Data Report to use Liberty Island (instead of Prospect Slough) data for reporting conditions at Cache Slough.	Jay Davis	04/30/18	Complete	Changes to the report were made by the Principal Investigators, Jay Davis at SFEI and Wes Heim at the Moss Landing Marine Laboratory. The changes only affect the historic data shown in Figure 4 of the report.
31	Coordinating Committee Meeting on 4/11/2018	04/11/18	Adam to contact Metropolitan Water District of Southern California (Met), the State Water Contractors (SWC) or the Association of California Water Agencies (ACWA) to inquire about their interest in joining the Delta RMP. Also possibly Sacramento Source Water Protection Program.	Adam Laputz	05/30/18	Complete	Email reminder sent 7/2/2018. SWC has said no, Adam to contact others.
32	Coordinating Committee Meeting on 4/11/2018	04/11/18	Adam to contact the Delta Science Program (DSP) to see if they are interested in a seat on the Steering Committee. If they are interested, he should introduce an agenda item at a future SC meeting about creating additional seats on the SC to represent… Science? Research?	Adam Laputz	05/30/18	Complete	Email reminder sent 7/2/2018. Adam has tried contacting Reiner.
33	Coordinating Committee Meeting on 4/11/2018	04/11/18	Adam to request Gita Kapahi to continue working with us as a facilitator for the TAC into next year. If she is not available, to investigate other alternatives.	Adam Laputz	05/30/18	Complete	
34	Pesticides Subcommittee Meeting on 4/18/2018	04/18/18	Matt to work with Jim Orlando on budget and logistics for field sampling (by May 15).	Matthew Heberger	05/15/18	Complete	
35	Pesticides Subc. Meeting on 4/18/2018	04/18/18	Matt to work with GIS specialists and statistician Aroon on developing the appropriate sample frame and then doing the GRTS draw (by May 7).	Matthew Heberger	05/07/18	Complete	
36	Pesticides Subc. Meeting on 4/18/2018	04/18/18	ASC staff to finalize proposals (including costs). Matt to send draft proposals to the subcommittee (by May 18).	Matthew Heberger	05/18/18	Complete	
37	Pesticides Subc. Meeting on 4/18/2018	04/18/18	Subcommittee members to send feedback to be sent via email unless something critical comes up and a member suggests a meeting is necessary (by May 25)	Pesticides Subcommittee	05/25/18	Complete	
38	Pesticides Subc. Meeting on 4/18/2018	04/18/18	Revised proposal to be included in TAC agenda package for June 12 meeting (by June 4).	Matthew Heberger	06/04/18	Complete	
39	Pesticides Subc. Meeting on 4/18/2018	04/18/18	TAC members to fill in the decision grid ranking questionnaires for the 2 proposals during the week before and after the TAC meeting. Matt will compile the results of the ranking and distribute to the TAC. An additional short followup phone meeting will be scheduled if necessary and requested by TAC members.	TAC members	06/04/18	Complete	
40	Pesticides Subc. Meeting on 4/18/2018	04/18/18	Matt to schedule another subcommittee meeting for June to discuss issues related to the sampling program, toxicity testing with Ceriodaphnia, and any other items of interest. (by May 20)	Matthew Heberger	05/20/18	Complete	Since most of the issues in play were related to toxicity, and fairly technical, we convened a meeting of an ad hoc toxicity working group. This group met on .
41	TAC Action Items 4/23/2018	04/23/18	Correct attendance roster for past TAC meeting to add Steve Louie.	Matthew Heberger	04/30/18	Complete	
42	TAC Action Items 4/23/2018	04/23/18	Request our consulting statistician to pass on pertinent files to contractor for pesticides interpretive report.	Matthew Heberger	04/30/18	Complete	
43	TAC Action Items 4/23/2018	04/23/18	Move recommendation for the contractor forward to the steering committee.	Matthew Heberger	05/05/18	Complete	
44	TAC Action Items 4/23/2018	04/23/18	Add “n/a” as a response option on future decision grid questionnaire surveys	Matthew Heberger	05/15/18	Complete	
45	TAC Action Items 4/23/2018	04/23/18	Follow up with SFEI staff to find out if we are calculating mercury loading at Mallard Island.	Matthew Heberger	04/30/18	Complete	
46	TAC Action Items 4/23/2018	04/23/18	Add a cover sheet to the monitoring proposals which shows the rankings and summarizes the process (explains how the numbers were derived/what they mean)	Matthew Heberger	05/05/18	Complete	Drafted a 5-page memo which describes this year’s proposal development, selection, and ranking process. Includes passages from the Decision Grid materials developed last year by a stakeholder-led working group.
47	TAC Action Items 4/23/2018	04/23/18	Schedule a meeting for mercury subcommittee to develop a more detailed plan about when to sample high flows/storms etc.	Jay Davis	05/30/18	Complete	
48	TAC Action Items 4/23/2018	04/23/18	Provide additional detail on what a scaled down Mercury proposal might look like (if only spending 250k)	Jay Davis	04/30/18	Complete	

	Primary	Meeting Date	Deliverable	Assigned To	Due Date	Status	Comments
49	TAC Action Items 4/23/2018	04/23/18	Pesticides project planning, Evaluate the costs of running fathead minnow, rainbow trout, and Chironomus. And confirm with AHPL and USGS on feasibility of running tests on both test species and collecting the large volumes of sample water required.		05/15/18	Complete	Have confirmed with Jim Orlando and Marie Stillway that it is NOT feasible to run both fish species at once. Physical limitations based on the water volumes required, bench space, refrigeration, power load.
50	TAC Action Items 4/23/2018	04/23/18	Extend deadline for submission of comments on the AHPL Toxicity Report beyond May 10th.		04/30/18	Complete	
51	TAC Action Items 4/23/2018	04/23/18	Schedule a meeting of an ad hoc toxicity working group to discuss issue regarding the toxicity data interpretation (high variability, low EC samples). Work with Cam and Debra to figure out materials for meeting.	Matthew Heberger	05/15/18	Complete	
52	TAC Action Items 4/23/2018	04/23/18	Provide update on status of selection of science advisors at next TAC mtg.	Matthew Heberger	06/01/18	Complete	Placed on agenda for June meeting
53	Data Management Subcommittee Meeting on 4/25/2019	04/25/18	Send the final meeting summary	Matthew Heberger	05/10/18	Complete	
54	Data Management Subcommittee Meeting on 4/25/2020	04/25/18	Send the Data Management SOP to the group once our QAO has had a chance to review it.	Matthew Heberger	05/15/18	Complete	
55	Data Management Subcommittee Meeting on 4/25/2020	04/25/18	Create some graphics or a flowchart that shows how we manage data	Amy Franz	05/31/18	Complete	
56	Finance Committee 5/2/2018	05/02/18	For the next finance update, also include a project progress update. Highlight progress on deliverables, any changes that have been made to monitoring plans, warning of any delays.	Matthew Heberger	09/30/18		To be included in the next Finance Update and at subsequent SC meetings. It became clear that the "stoplight reports" are not serving the needs of the group, who wish to have greater insight into project progress.
57	Finance Committee 5/2/2018	05/02/18	Create a spreadsheet that we can share with Finance Committee members that show more financial details (Selina to provide template)	Matthew Heberger	07/15/18	Complete	I reminded Selina about this and she no longer remembered what this was.
58	Informal Action Items 2018	05/07/18	Create a poster for the Bay Delta Science Conference and present it to the SC for approval at their July 2018 meeting	Matthew Heberger	07/07/18	Complete	Notification sent via email as it was not ready in time for the SC meeting in July. Poster presented at BDSC, Sept 10 -12.
59	SC Action Items 5/11/2018	05/11/18	Finalize the February 5, 2018 & March 2, 2018 Meeting Summaries and post to the website.	Matthew Heberger	05/30/18	Complete	
60	SC Action Items 5/11/2018	05/11/18	Circulate a Doodle Poll to select a date for the Fall Joint SC/TAC Meeting. (Matt Heberger	Matthew Heberger	05/30/18	Complete	Meeting scheduled for Oct 29, 2018 at the Cal/EPA building.
61	SC Action Items 5/11/2018	05/11/18	Distribute login information for the TAC web site to the committee. Utilize a push notification for updates going forward.	Matthew Heberger	05/30/18	Complete	Detailed instructions sent on May 17 to TAC and SC members, subject line "How to Access Delta RMP Data." I have also put most of this information on a new page on our TAC workspace website for easy reference. Visit https://sites.google.com/a/sfei.org/delta-rmp/ and click "Data Access."
62	SC Action Items 5/11/2018	05/11/18	Technical Committee should discuss co-chair/chair needs and bring recommendation to the next Steering Committee meeting	Stephen McCord	07/17/18	Complete	Discussed by the TAC at its June 12 meeting. See meeting summary for details.
63	SC Action Items 5/11/2018	05/11/18	Consider submitting a Prop 1 funding for the CEC Study and Pesticides Monitoring. This item should be added to the next TAC meeting agenda.	Matthew Heberger	06/04/18	Complete	We looked into the possibility and did not see it as a good fit. One challenge is that the program does not have in place an approved pesticides monitoring design which could be expanded through grant funding. Another challenge is that this grant program is for "studies" and not ongoing monitoring, and there needs to be a strong link to wildlife.
64	SC Action Items 5/11/2018	05/11/18	Put in place subcontract with Deltares (for the Pesticides Interpretive Report)	Matthew Heberger	06/15/18	Complete	
65	SC Action Items 5/11/2018	05/11/18	Finance Subcommittee will discuss the options/framework for an overall funding process and how to make the process more efficient and bring a proposal to the next Steering Committee meeting.	Dalia Fadl	06/30/18	Complete	The finance committee held a meeting to discuss financing options on June 19.

	Primary	Meeting Date	Deliverable	Assigned To	Due Date	Status	Comments
66	SC Action Items 5/11/2018	05/11/18	Technical Advisory Committee will develop a strategic plan for utilizing the Science Advisors	TAC members	06/30/18	Complete	
67	Informal Action Items 2018	05/16/18	Put in place a contract between ASC and Caltrans so that they can contribute financially to the Delta RMP and fulfill their requirements to conduct Delta Mercury Control Program (Delta Mercury TMDL) monitoring and other monitoring in the Delta. Approval letter from RB5 dated 2018-05-16 (on file).	Patrick Walsh	10/15/18		ASC staff have been working with Patrick Morris at the Regional Bard and Tom Rutsch at Caltrans since May 2019 to negotiate a contract. Patrick Walsh, ASC's Director of Finance & Contracts, sent the most recent version to Caltrans on 2018-09-20. Matt phoned Tom on 2018-10-02 to inquire on the status, and Tom promised to reply by the week of Oct 8.
68	Coordinating Committee Meeting on June 7, 2018	06/07/18	Debbie agreed to talk to her technical advisors about the issues with the toxicity lab to ensure that we are adequately dealing with concerns about past data and are able to move forward with seeking approval of a plan for the upcoming year.	Debbie Webster	06/28/18	Complete	
69	Coordinating Committee Meeting on June 7, 2018	06/07/18	Send pesticides monitoring proposals to our expert advisors	Matthew Heberger	06/28/18	Complete	
70	Coordinating Committee Meeting on June 7, 2018	06/07/18	Confirm whether Melissa Turner is still willing and able to give a presentation about ILRP monitoring	Matthew Heberger	06/28/18	Complete	
71	Coordinating Committee Meeting on June 7, 2018	06/07/18	Add information on population to Matt's spreadsheet of Delta RMP contributors and their amounts.	Selina Cole	06/28/18	Complete	
72	Coordinating Committee Meeting on June 7, 2018	06/07/18	Consider organizing special meeting of SC delegates to discuss pesticides proposals between June 25 and July 3	Debbie Webster	06/28/18	Complete	
73	Coordinating Committee Meeting on June 7, 2018	06/07/18	Call the Army Corps today and remind them that they need to make their $50K contribution promptly. They are under an MOU to pay within 15 days.	Matthew Heberger	06/07/18	Complete	
74	TAC Action Items 06/12/2018	06/12/18	Set a meeting of the Pesticides Subcommittee Meeting, Friday, November 9, 2018, 3-4 hours, to meet with the team from Deltares	Matthew Heberger	06/30/18	Complete	
75	TAC Action Items 06/12/2018	06/12/18	Set a "supplemental" meeting of the TAC for June 29, phone and online only. Purpose is to review and make a recommendation on the pesticides monitoring proposals.	Matthew Heberger	06/15/18	Complete	
76	TAC Action Items 06/12/2018	06/12/18	Draft a scope of work for toxicity reporting that describes a smaller effort to bring the total estimated costs closer to the 250k proposed budget.	Matthew Heberger	06/15/18	Complete	ASC staff worked with AHPL lab manager to develop a quote for supplemental information provided to us at a cost of $15K, rather than the $50K report.
77	TAC Action Items 06/12/2018	06/12/18	Revise the ranking questionnaire (for the pesticides monitoring design) with suggested edits and distribute to the TAC. The TAC will then have a week to complete the rankings.	Matthew Heberger	06/30/18	Complete	
78	TAC Action Items 06/12/2018	06/12/18	Follow up with swamp on flagging of Chironomus toxicity data, specifically what is the meaning and implication of being flagged as "survey data."	Beverly Anderson-Abbs	06/30/18	Complete	
79	TAC Action Items 06/12/2018	06/12/18	Clarify what action/feedback is being requested from the steering committee at July 17, 2018 meeting on the CEC monitoring proposal.	Brian Laurenson	06/30/18	Complete	
80	TAC Action Items 06/12/2018	06/12/18	Include an agenda item in the July 17, 2018 steering committee meeting agenda to evaluate compensation for the TAC chair	Matthew Heberger	06/30/18	Complete	Following discussion with the Coordinating Committee, it was agreed to handle this as part of the FY19/20 budgeting process.
81	TAC Action Items 06/12/2018	06/12/18	For the memo "Plan for Science Advisor Input in FY18/19," add the names of the list of science advisors with the overall calendar of milestones/due dates. Add the following phrase at the end of the second sentence in the science advisor job description: "…to better support the goals of the Delta RMP."	Matthew Heberger	08/31/18	Complete	
82	TAC Action Items 06/29/2018	06/29/18	Find out how Chironomus toxicity data will be flagged in CEDEN and what implications that has for use by regulators	Beverly Anderson-Abbs	07/12/18	Complete	

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83	TAC Action Items 06/29/2018	06/29/18	Schedule meetings of the Pesticides Subcommittees and Toxicity Workgroup for July and August	Matthew Heberger	07/12/18	Complete	
84	TAC Action Items 06/29/2018	06/29/18	Send a track changes version to TAC members to show exactly what changed	Matthew Heberger	07/01/18	Complete	
85	TAC Action Items 06/29/2018	06/29/18	TAC members with any additional comments, especially any dissenting opinions should send any additional comments or feedback	TAC members	07/01/18	Complete	
86	TAC Action Items 06/29/2018	06/29/18	Stephen McCord to send his “talking points” about the proposal to TAC members for review	Stephen McCord	07/10/18	Complete	
87	TAC Action Items 06/29/2020	06/29/18	Distribute slide presentation about the pesticides monitoring proposal to TAC members	Matthew Heberger	07/12/18	Complete	
88	Finance Committee 7/2/2018	07/02/18	From now on, do not change budgets unless there has been a major change in scope or deliverables. Keep budgets the same and maybe spend more or less on different tasks and subtasks but don't actually transfer money in the budget.	Matthew Heberger	12/31/18	Complete	Implementing this new policy beginning in FY18/19. In the past, we re-allocated funds among subtasks at the request of the Finance Committee. At the time, they preferred that we "move $2,000 from Task 1A to 1B" rather than simply going overbudget on one task and staying under on another. From our point of view, either practice is acceptable, although the former is simpler.
89	SC Action Items 7/17/2018	07/17/18	Verify that the budget in the workplan is correct, and reflects the 50% funding approved for the chlorophyll-a sensor intercalibration study.	Matthew Heberger	07/27/18	Complete	It was correct.
90	SC Action Items 7/17/2018	07/17/18	Put Multi-Year Planning on the agenda for the Fall Joint Meeting.	Matthew Heberger	09/28/18	Complete	
91	SC Action Items 7/17/2018	07/17/18	As we are planning the pesticides study, make sure we take into consideration the ILRP monitoring that is occurring at Ulatis Creek, to make sure that we are not duplicating efforts.	Matthew Heberger	09/28/18	Complete	
92	SC Action Items 7/17/2018	07/17/18	Send suggested edits of the mercury data report to ASC.	Steering Committee	07/27/18	Complete	
93	SC Action Items 7/17/2018	07/17/18	At the next SC meeting, the data management subcommittee should give a report on its findings and recommendations. This update should include updated recommendations on last year's planned Data Assessment Framework Workshop.	Matthew Heberger	09/28/18	Complete	I have included this on the agenda for the meeting, and the co-leaders of this subcommittee are preparing a report.
94	Informal Action Items 2018	07/19/18	Ask subcommittees whether there are projects or reports that would benefit from feedback from our science advisors	Matthew Heberger	08/31/18	Complete	Placed on the agenda for the Pesticides Subcommittee
95	Informal Action Items 2018	07/20/18	Adam to speak to Tom Mumley regarding Contra Costa County's contribution to the Delta RMP. The County has a Phase 1 MS4 permit for its unincorporated areas. It straddles both Region 2 (Bay) and Region 5 (Central Valley), however the majority of the population is in the Bay. In 2015, there was discussion of asking them to contribute to the Delta RMP. RB5 staff and leadership would like for the County to begin paying their fair share to the Delta RMP.	Adam Laputz	08/31/18	Complete	Adam informed Matt in Sept 2018 that this conversation took place. Central Valley Board staff should follow up with Contra Costa County if their stormwater discharge permit will be modified to require their participation in the Delta RMP.
96	Pesticides Subcommittee Meeting on 8/1/2018	08/01/18	Share Deltares contract with the Pesticides Subcommittee (so they can see timeline and deliverables)	Matthew Heberger	08/03/18	Complete	
97	Pesticides Subcommittee Meeting on 8/1/2018	08/01/18	Consider putting a discussion of human health impacts of contaminants on the agenda for the Fall Joint Meeting	Matthew Heberger	10/01/18	Complete	This recommendation came out of a discussion at the Pesticides Subcommittee where we were reacting to a newspaper article on the use of glyphosate in the Delta. The TAC was decidedly less enthusiastic about this idea when we discussed it on 9/21.
98	Pesticides Subcommittee Meeting on 8/1/2018	08/01/18	Plan a presentation about GRTS for the next meeting of the Pesticides Subcommittee on 8/28.	Aroon Melwani	08/22/18	Complete	
99	Pesticides Subcommittee Meeting on 8/1/2018	08/01/18	Research the issue of GRTS sample draw along polylines vs. in polygons, perform a brief literature review, speak to experts and advisors, and come back to the group with options at our next meeting	Matthew Heberger	08/15/18	Complete	

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100	Pesticides Subcommittee Meeting on 8/1/2018	08/01/18	Share DPR's criteria for storm sampling with the group.	Cam Irvine	08/15/18	Complete	
101	Pesticides Subcommittee Meeting on 8/1/2018	08/01/18	Add Alisha Wenzel to the list of people to be informed regarding TIEs.	Patrick Morris	08/15/18	Complete	
102	Pesticides Subcommittee Meeting on 8/1/2018	08/01/18	A subset of subcommittee members agreed to help draft relevant sections of the QAPP related to toxicity	Cam Irvine	08/21/18	Complete	
103	Informal Action Items 2018	08/13/18	Respond in writing to Melissa Turner's comments on the FY16/17 Pesticides data and QA memo	Don Yee	08/31/18	Complete	
104	CEC Subcommittee Meeting 8/22/2018	08/22/18	Consult with colleagues to provide a review of the budget with consideration of a more detailed plan	Matthew Heberger	08/31/18	Complete	
105	CEC Subcommittee Meeting 8/22/2018	08/22/18	Develop a timeline/Gantt Chart prior to the Joint Meeting to include interim deliverables and points for stakeholder input.	Matthew Heberger	10/15/18		
106	CEC Subcommittee Meeting 8/22/2018	08/22/18	Provide a timeline for the QAPP and information that can be provided to the Joint Meeting	Matthew Heberger	10/15/18		
107	CEC Subcommittee Meeting 8/22/2018	08/22/18	Develop a budget for Prop 1 application and notify the co-chairs and Finance Committee of intent to apply.	Matthew Heberger	10/26/18	Complete	
108	CEC Subcommittee Meeting 8/22/2018	08/22/18	Fill in technical details for the sampling plans including sampling methods and number of clams needed	Matthew Heberger	11/30/18		
109	CEC Subcommittee Meeting 8/22/2018	08/22/18	Ask Melissa Morris whether an individual QAPP or a QAPP added to the Delta RMP is preferred.	Dawit Tadesse	08/31/18	Complete	Confirmed 23 August 2018 the QAPP should be developed as an individual plan
110	CEC Subcommittee Meeting 8/22/2018	08/22/18	Provide a link to the Hood CEC study.	Brian Laurenson	08/31/18	Complete	Link sent via email on 22 August 2018.
111	CEC Subcommittee Meeting 8/22/2018	08/22/18	Provide CEC Reports from Region 1 and Region 4.	Dawit Tadesse	08/31/18	Complete	Reports sent via email on 23 August 2018
112	CEC Subcommittee Meeting 8/22/2018	08/22/18	Update the CEC subcommittee on progress regarding the SEP policy amendment and development of the SEP proposal.	Patrick Morris	09/30/18		
113	Pesticides Subcommittee Meeting on 8/28/2018	08/28/18	Create a series of maps for the subcommittee, showing channels classified by depth,e.g. 2m, 3m, 4m	Matthew Heberger	09/05/18	Complete	
114	Pesticides Subcommittee Meeting on 8/28/2018	08/28/18	Create 2-3 different "GRTS draws" demonstrating the effect of unequal probabilities	Aroon Melwani	09/05/18	Complete	
115	Pesticides Subcommittee Meeting on 8/28/2018	08/28/18	Run queries against the DPR PUR database on common almond pesticides, to determine when they are applied in the Delta	Scott Wagner	09/08/18	Complete	
116	Pesticides Subcommittee Meeting on 8/28/2018	08/28/18	Ask SFEI QA officer about whether he would support forgoing field dupes for toxicity testing	Matthew Heberger	09/08/18	Complete	
117	Pesticides Subcommittee Meeting on 8/28/2018	08/28/18	Clarify whether SWAMP will pay for field duplicates for water toxicity tests through its contract with AHPL, or whether funding for field dupes would have to come out of Delta RMP funds.	Matthew Heberger	09/08/18	Complete	Rate of field duplicates of 5%. Only results in 3 additional env. samples per year, not a large additional expense.
118	Pesticides Subcommittee Meeting on 9/13/2018	09/13/18	Revise the analyte list in the Quality Assurance Program Plan (QAPP) based on new information from Jim Orlando	Matthew Heberger	09/25/18	Complete	
119	Pesticides Subcommittee Meeting on 9/13/2018	09/13/18	send committee members Google Earth (KML) files of the sample frame (waterways classified as deep/shallow), and the points generated by GRTS, so that each member can review in "high def" by zooming in.	Matthew Heberger	09/18/18	Complete	
120	Pesticides Subcommittee Meeting on 9/13/2018	09/13/18	Include a brief writeup in our sampling plan explaining why we chose the 2.5 m depth cutoff (balance between deep/shallow, ecological significance, looked right based on members knowledge of the Delta).	Matthew Heberger	09/28/18	Complete	
121	Toxicity Work Group Meeting on 9/13/2018	09/13/18	Marie to double check whether her lab can report biomass as an additional endpoint without incurring additional expense or running afoul of their contract with SWAMP.	Marie Stillway	10/01/18	Complete	Marie confirmed that her lab can report biomass at no additional expense.
122	Toxicity Work Group Meeting on 9/13/2018	09/13/18	Share working draft of the QAPP with subcommittee members	Matthew Heberger	09/15/18		

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123	Toxicity Work Group Meeting on 9/13/2018	09/13/18	Send a reminder of how to access files on the Technical Advisory Committee (TAC) workspace website.	Matthew Heberger	09/30/18	Complete	Detailed instructions for how to access Delta RMP data are here: https://sites.google.com/a/sfei.org/delta-rmp/data-access
124	Toxicity Work Group Meeting on 9/13/2018	09/13/18	AHPL to to send revised data to SWAMP where C. dubia tests were terminated at the wrong time.	Marie Stillway	10/15/18	Complete	Marie confirmed that she sent revised results to Brian Ogg at the State Water Board in the last week of Sept 2018.
125	Toxicity Work Group Meeting on 9/13/2018	09/13/18	Get Melissa Morris' input on the mid-range EC control issue.	Matthew Heberger	10/01/18	Complete	
126	Pesticides Subcommittee Meeting on 9/20/2018	09/20/18	Send the final sample frame shapefile to Joe D. and Jim O.	Matthew Heberger	10/01/18	Complete	
127	TAC Action Items 09/21/2018	09/21/18	Schedule doodle poll for next pesticides subcommittee meeting	Matthew Heberger	10/07/18		
128	TAC Action Items 09/21/2018	09/21/18	Revise the June 29 tac summary; in the paragraph beginning “one tac member noted…” to replace the “would not” with “may not be useful.”	Matthew Heberger	09/30/18	Complete	
129	TAC Action Items 09/21/2018	09/21/18	Revise pathogens monitoring final report with committee comments. Committee members to submit final comments no later than Tuesday, 9/25.	Brian Lauerson	10/15/18	Complete	
130	TAC Action Items 09/21/2018	09/21/18	Request TAC approval of the FY16/17 Pesticides data at the joint meeting agenda, prior to an SC vote on whether to approve and publish. (TAC members wanted more time to review the data.)	Matthew Heberger	10/15/18	Complete	
131	TAC Action Items 09/21/2018	09/21/18	Jim Orlando requested Matt send him a copy of the appendix to the QAPP.	Matthew Heberger	10/15/18	Complete	
132	TAC Action Items 09/21/2018	09/21/18	Invite one or more science advisors to the November 9, 2018 pesticides subcommittee (with Deltares). Also, schedule a one hour meeting with the science advisors (without Delatares) after the subcommittee meeting.	Matthew Heberger	10/15/18		
133	TAC Action Items 09/21/2018	09/21/18	Include a specific science advisor engagement plan in next year’s work plan.	Matthew Heberger	04/15/19		
134	TAC Action Items 09/21/2018	09/21/18	Work with Cam Irvine to revise tox testing information in presentation.	Matthew Heberger	10/15/18		Recorded by Daphne. Emailed Cam to disambiguate.
135	TAC Action Items 09/21/2018	09/21/18	Matt will develop a timeline for completion of the QAPP and distribution to the TAC for review and approval. This will be added to the agenda of the next pesticides subcommittee (date TBD).	Matthew Heberger	10/05/18		
136	TAC Action Items 09/21/2018	09/21/18	Matt will begin the process of securing funding and assistance for writing a CEC-related prop 1 proposal. CEC subcommittee could also assist ASC in writing and review of the proposal.	Matthew Heberger	10/05/18	Complete	
137	TAC Action Items 09/21/2018	09/21/18	Matt will look into securing a guest speaker for October 29th joint meeting.	Matthew Heberger	10/15/18	Complete	
138	TAC Action Items 09/21/2018	09/21/18	Incorporate the following suggested items from the committee into the joint meeting agenda (see meeting summary for list)	Matthew Heberger	10/15/18	Complete	
139	TAC Action Items 09/21/2018	09/21/18	Ask Dave Mount from EPA his expert opinion on the use of an alternative mid-range conductivity control for toxicity testing with Ceridaphnia dubia	Matthew Heberger	10/03/18	Complete	Received an email from Debra Denton with Dr. Mount's comments on Oct 3.
140	TAC Action Items 09/21/2018	09/21/18	Propose that OIMA revise the memo on the use of low-conductivity controls for toxicity testing with Ceriodaphnia dubia.	Matthew Heberger	10/03/18	Complete	Informed by Melissa Morris via email on Oct 2 that they are considering revising their guidance documents, but the timeline is uncertain.
141	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Regarding Deltares’ literature search and “gray literature,” be sure that it includes recent monitoring overviews, especially those by Delta RMP members Joe Domagalski and Debra Denton.	Erwin Roex	11/09/18	Complete	Sent these documents to Erwin Roex, PI.

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142	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Look into adding data from California Integrated Water Quality System (CIWQS, commonly pronounced “sea-wicks”), especially any ambient or receiving water samples. (This came with a reminder that we are analyzing water quality conditions in the Delta, not estimating loadings or investigating pollutant sources).	Erwin Roex	11/09/18	Complete	Erwin Roex has corresponded about this with Debra Denton and Joe Domagalski.
143	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Include the “Legal Delta” boundary on future maps. Matt to send the “legal Delta boundary” shape file to Erwin.	Matthew Heberger	09/30/18	Complete	
144	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Erwin to contact Xuyang Zhang at DPR to resolve discrepancies in the SURF database. The SURF database may include information that are not included elsewhere and should be included. Xuyang will help resolve questions, e.g. clarify what fraction the results represent (suspended sediment, dissolved, or total)/	Erwin Roex	10/15/18	Complete	
145	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Matt to look into the data that was recently added to the Regional Data Center (and CEDEN) by SFEI, check whether there is data that should be included for this study, and verify that it is included in the Deltares database.	Matthew Heberger	09/30/18	Complete	Here is an article about the project where SFEI digitized and uploaded dozens of "legacy" datasets to the Regional Data Center and CEDEN. Since these data are all in CEDEN, they were included in the download by Deltares scientists. https://www.sfei.org/news/completed-deduce-delta-environmental-data-understanding-california-estuary#sthash.CHfgJwe8.dpbs
146	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Xuyang Zhang agreed to provide to Deltares a list of pesticides registered for use in California from 2011 to present.	Xuyang Zhang	10/07/18	Complete	Emailed on Oct 5.
147	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Deltares hand selected compounds to remove from their database to exclude non-pesticides (pharmaceuticals, industrial chemicals) based on their expert judgment. Erwin agreed to share list of excluded parameters to confirm none are pesticides.	Erwin Roex	10/15/18		
148	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Danny McClure agreed to send (via Matt at ASC) additional information about pyrethroids bioavailability.	Danny McClure	10/07/18		
149	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Confirm that USGS data includes analyses from all 3 labs that have participated in Delta studies: KS, CO, CA.	Erwin Roex	10/15/18	Complete	Shortly after the meeting, Joe Domagalski confirmed that all 3 were included.
150	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Joe Domagalski to provide a cross-walk table that relates USGS “parameter codes” to CAS Registry Numbers.	Joe Domagalski	10/07/18	Complete	
151	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Where the pesticide data from CEDEN had FRACTION = “not recorded,” it may be possible to determine this information based on the project. Danny McClure agreed to help research this.	Danny McClure	10/15/18		
152	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Deltares team to confirm that they are dealing with QA samples appropriately. Some of the data in CEDEN represent samples that were collected for QA purposes, such as field blanks, field duplicates, matrix spikes, etc.	Erwin Roex	11/09/18		Include description in next deliverable.
153	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	In some occasions, toxicity identification evaluations (TIEs) were performed as a followup to positive toxicity tests. These data are not readily available via the public interface to CEDEN. Melissa Turner volunteered to help provide these data to Deltares.	Melissa Turner	10/15/18		
154	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Some of the values in the “Result” field were negative. Deltares assumed these were errors and deleted them. However, they may be meaningful. Consider investigating these to verify these do not contain some “coded” information. Matt to check with ASC’s data management team.	Matthew Heberger		Complete	According to the CEDEN "Chemistry Data Submission Guidance Document," the Result field may be blank. It says nothing about inserting negative values. Project scientists should look at the corresponding values in the field ResQualCode. For information on possible values and their meaning, see: http://ceden.org/CEDEN_Checker/Checker/DisplayCEDENLookUp.php?List=ResQualLookUp

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155	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Distribute to members a “primer” or useful background materials on the use of species sensitivity distributions (SSD) and the multi-species potentially affected fraction (msPAF).	Matthew Heberger		Complete	Compiled a few references via internet search. Emailed research team to ask for other suggestions. Seems best reference is a highly-cited textbook from 2001 by Posthuma et al. Sent to Technical Advisory Committee and Pesticides Subcommittee with a suggestion to begin with Chapters 1 and 16.
156	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Deltares should consider performing simple analyses that will provide useful information to the Delta RMP and to regulators and paint a more complete picture than would be obtained with only a single method. For example, a simple summary of exceedances of EPA’s Aquatic Life Benchmarks. Matt to provide a link or table to Deltares.	Matthew Heberger	09/30/18	Complete	I confirmed that this is in fact required in their contract. It states that, at a minimum, the investigators shall compare observed pesticide concentrations to appropriate benchmarks.
157	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Have the Delta RMP science advisors review the proposed methods for the study; invite them to our forthcoming meeting of the Delta RMP.	Matthew Heberger	10/15/18		Update Oct 16: Erwin has requested postponing this meeting, since they have had trouble compiling the "definitive" database. (Changes keep being made to the toxicity data.)
158	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	The researchers should filter out sampling locations that represent ditches, farm ponds, etc. that are not connected to Delta waterways. The focus should be on Delta surface waters (not groundwater, and not other types of water, such as irrigation water). Matt can share GIS data of surface water features with Deltares that should be helpful for screening).	Matthew Heberger	09/30/18	Complete	Emailed the research team information and links to CARI and NHD, two GIS datasets of surface water features.
159	Pesticides Subcommittee Meeting on 9/25/2018	09/25/18	Consider rescheduling the Nov 9 Pesticides Subcommittee meeting to a later date, possibly hold a teleconference that day and meet again with Deltares in person at a later date.	Matthew Heberger	10/25/18		
160	Nutrients Subcommittee Action Items	09/25/18	Work with Janis to schedule subcommittee meetings for November, February, and March.	Matthew Heberger	10/15/18	Complete	
161	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Propose a deadline on our Data Management and Quality Assurance SOP, check with Melissa Morris that it’s acceptable.	Matthew Heberger	10/15/18		
162	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Provide an update on the Data Management and Quality Assurance SOP document to the Steering Committee.	Matthew Heberger	10/29/18	Complete	Update scheduled for Joint Meeting on 10/29.
163	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Patrick to write a 1-2 page memo explaining why DWR is in the program; their participation is required in 3 different permits covering barriers, eco-restore, etc. Include in this memo the current participant categories, e.g. stormwater, wastewater, regulatory-state, etc.	Patrick Morris	10/15/18	Complete	
164	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Send a note to the Steering Committee: Ask members whether they have any changes to the Charter?	Matthew Heberger	10/08/18	Complete	
165	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Consider a change to the Charter so that the TAC does not require co-chairs.	Matthew Heberger	10/15/18	Complete	Agendized for 10/29 meeting.
166	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Consider allowing alternates for the Steering Committee chairs.	Matthew Heberger	10/15/18	Complete	Agendized for 10/29 meeting.
167	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Invite Mike Wackman and Stephen McCord to future Coordinating Committee Meetings.	Matthew Heberger	10/29/18	Complete	
168	Coordinating Committee Meeting on Oct 6, 2018	10/06/18	Send calendar invitations for planned meetings	Matthew Heberger	10/15/18	Complete	
169	CEC Subcommittee Meeting 10/10/2018	10/10/18	Prepare a proposed schedule (Gantt chart) with interim deliverables and opportunities for input for the CEC Subcommittee to review before inclusion in the agenda package for the SC/TAC Joint Meeting	Matthew Heberger	10/16/18		
170	CEC Subcommittee Meeting 10/10/2018	10/10/18	Work with Brian Laurenson on a report out for the SC/TAC Joint Meeting	Matthew Heberger	10/21/18		
171	CEC Subcommittee Meeting 10/10/2018	10/10/18	Obtain letters of support for the CEC Prop 1 grant proposal	Matthew Heberger	10/21/18		

Materials for Agenda Item 8

Mercury Monitoring for FY18/19 Workplan

Continued monitoring of sport fish and water will address the highest priority information needs related to implementation and revision of the Methylmercury TMDL (re-opening of the TMDL is tentatively scheduled for 2020). Annual monitoring of sport fish will firmly establish baseline concentrations and interannual variation in support of monitoring of long-term trends as a critical performance measure for the TMDL. Monitoring of water on a near-monthly basis will solidify the linkage analysis (the quantitative relationship between methylmercury in water and methylmercury in sport fish) in the TMDL and be valuable in verifying trends and patterns predicted by a numerical model of methylmercury transport and cycling being developed for the Delta and Yolo Bypass by the California Department of Water Resources (DWR) – this model will allow testing of various water management scenarios.

The cost for this workplan for mercury monitoring, with 8 water sampling events, is **$277,210**.

Should additional funds become available, higher-cost options have been scoped:

- 10 water sampling events: $323,798
- 9 water sampling events: $300,504

If additional funding becomes available during the fiscal year, the Mercury Subcommittee will discuss how to spread the events throughout the months of the year.

Management Drivers Addressed

Mercury monitoring addresses the Delta Methylmercury TMDL, which establishes goals for cleanup and calls for a variety of control studies and actions.

Assessment Questions Addressed

Two tiers of assessment questions have been defined for the mercury monitoring program. **Primary** assessment questions are those that are explicitly addressed by the monitoring and drive the monitoring design. **Secondary** assessment questions are addressed to some extent by the monitoring, but are not drivers of the monitoring design. The monitoring will contribute some information on but will not fully answer the secondary assessment questions.

Primary Assessment Questions

Status and Trends

ST1. What are the status and trends in ambient concentrations of methylmercury and total mercury in sport fish and water, particularly in subareas likely to be affected by major existing or new sources (e.g., large-scale restoration projects)?

ST1.A. Do trends over time in methylmercury in sport fish vary among Delta subareas?

Sources, Pathways, Loadings & Processes

SPLP1. Which sources, pathways and processes contribute most to observed levels of methylmercury in fish?

SPLP1.A. What are the loads from tributaries to the Delta (measured at the point where tributaries cross the boundary of the legal Delta)?

Fish-Water Linkage Analysis
(new priority question articulated by Mercury Subcommittee)

FWLA1. Are there key datasets needed to strengthen the technical foundation of contaminant control programs?

Secondary Assessment Questions

Status and Trends

ST1. What are the status and trends in ambient concentrations of methylmercury and total mercury in sport fish and water, particularly in subareas likely to be affected by major existing or new sources (e.g., large-scale restoration projects)?

ST1.B. How are ambient levels and trends affected by variability in climate, hydrology, and ecology?

Sources, Pathways, Loadings & Processes

SPLP1. Which sources, pathways and processes contribute most to observed levels of methylmercury in fish?

SPLP1.B. How do internal sources and processes influence methylmercury levels in fish in the Delta?

SPLP1.C. How do currently uncontrollable sources (e.g., atmospheric deposition, both as direct deposition to Delta surface waters and as a contribution to nonpoint runoff) influence methylmercury levels in fish in the Delta?

Forecasting Scenarios

FS1. What will be the effects of in-progress and planned source controls, restoration projects, and water management changes on ambient methylmercury concentrations in fish in the Delta?

Data Quality Objectives/Null Hypothesis

The initial and preliminary data quality objective (DQO) is the ability to detect a trend of mercury in fish tissue of 0.040 ppm/yr. This DQO can be refined when additional data are available. The null hypothesis is that there is no trend. MQOs are identical to those used in other mercury studies throughout the state and the country for determinations of impairment and trend detection. These MQOs generally call for indices of accuracy and precision to be within 25% to 30% of expected values.

Monitoring to Support Implementation of the Methylmercury TMDL

Executive Summary

Continued monitoring of sport fish will address the highest priority information needs related to implementation and revision of the Methylmercury TMDL (re-opening of the TMDL is tentatively scheduled for 2020). Annual monitoring of sport fish will firmly establish baseline concentrations and interannual variation in support of monitoring of long-term trends as a critical performance measure for the TMDL. Monitoring of water on a near-monthly basis will solidify the linkage analysis (the quantitative relationship between methylmercury in water and mercury in sport fish) in the TMDL and be valuable in verifying trends and patterns predicted by a numerical model of methylmercury transport and cycling being developed for the Delta and Yolo Bypass by the California Department of Water Resources (DWR) - this model will allow testing of various land and water management scenarios.

Background and Motivation

Concentrations of methylmercury in fish from the Delta exceed thresholds for protection of human and wildlife health. The Methylmercury TMDL (Wood et al. 2010) is the driver of actions to control methylmercury in the Delta, establishing water quality goals and directing various discharger groups to conduct monitoring and implement measures to minimize methylmercury impairment of beneficial uses.

The TMDL established three water quality objectives for methylmercury in fish tissue: 0.24 ppm in muscle of large, trophic level four (TL4) fish such as black bass; 0.08 ppm in muscle of large TL3 fish such as carp; and 0.03 ppm in whole TL2 and TL3 fish less than 50 mm in length. Furthermore, the TMDL established an implementation goal of 0.24 ppm in largemouth bass at a standard size of 350 mm as a means of ensuring that all of the fish tissue objectives are met. Largemouth bass are widely distributed throughout the Delta and are excellent indicators of spatial variation due to their small home ranges. Past data for largemouth bass were a foundation for the development of the TMDL, including the division of the Delta into eight subareas. Monitoring of largemouth bass in these subareas therefore provides the most critical performance measure of progress in addressing methylmercury impairment in the Delta.

The TMDL describes a statistically significant relationship between the annual average concentration of methylmercury in unfiltered water and average mercury in 350 mm

largemouth bass when data are organized by subarea. This linkage provides a connection, essential for management, between methylmercury inputs from various pathways (e.g., municipal wastewater, municipal stormwater, agricultural drainage, sediment flux in open waters, and wetland restoration projects) and impairment of beneficial uses. Because of this linkage, the TMDL established an implementation goal of 0.06 ng/L of unfiltered aqueous methylmercury. In response to TMDL control study requirements, the Department of Water Resources (DWR) is leading development of numerical methylmercury transport and cycling simulation models for the Delta and Yolo Bypass. Monitoring of aqueous methylmercury is therefore needed to:

1) better quantify the fish-water linkage that is the foundation of the TMDL,
2) evaluate attainment of the TMDL implementation goal,
3) support calculations of mercury and methylmercury loads and mass balances,
4) support development of mercury models for the Delta and Yolo Bypass, and
5) support evaluation of the fish data by providing information on processes and trends.

In FY 2016/2017 the Delta RMP initiated a methylmercury monitoring program for fish and water. Largemouth bass were collected in late summer 2016 (September) from six locations distributed across the subareas. Quarterly sampling of methylmercury and mercury (and ancillary parameters) in water at five locations began in August 2016.

In FY 2017/2018, methylmercury monitoring of fish and water continued. Funding was allocated to sample fish at six locations and water at six locations for eight months. The eight months to be sampled were to be the March-October period used for the linkage analysis in the TMDL. In late 2017, the Mercury Subcommittee decided that a more optimal use of the available funds would be to shift to sampling water at eight locations (adding locations in the West Delta and at the export pumps) and to add sampling in January and February (Table 1). The FY 2017/2018 plan also included funds for quarterly sediment sampling to support the DWR methylmercury modeling effort, and any future methylmercury modeling. *No further sediment sampling is planned at this time.*

Table 2 summarizes the sampling frequency over the first two years of Delta RMP mercury monitoring, in terms of the number of events and sites sampled and the total number of samples collected. Table 2 also shows the planned sampling frequency for FY18/19 and the desired sampling frequency in FY19/20.

Applicable Management Decisions and Assessment Questions

The Delta Methylmercury TMDL is the embodiment of management decisions for methylmercury in the Delta, establishing goals for cleanup and calling for a variety of control studies and actions. With providing information to support TMDL implementation in mind, the Mercury Subcommittee carefully considered, refined, and prioritized the assessment questions articulated by the Steering Committee and Technical Advisory Committee for mercury.

Two tiers of assessment questions have been defined for the mercury monitoring program. **Primary** assessment questions are those that are explicitly addressed by the monitoring and drive the monitoring design. Secondary assessment questions are addressed to some extent by the monitoring, but are not drivers of the monitoring design. The monitoring will contribute some information but will not fully answer the secondary assessment questions.

Primary Assessment Questions

One priority question for this initial phase of methylmercury monitoring is from the Status and Trends category of the DRMP management and assessment questions:

Status and Trends

ST1. What are the status and trends in ambient concentrations of methylmercury and total mercury in sport fish and water, particularly in subareas likely to be affected by major existing or new sources (e.g., large-scale restoration projects)?

ST1.A. Do trends over time in methylmercury in sport fish vary among Delta subareas?

Question 1A is a high priority for managers that relates to the TMDL, and is a primary driver of the sampling design for fish monitoring. Annual monitoring of fish mercury is urgently needed to 1) firmly establish a baseline for each Delta subarea and 2) to characterize the degree of interannual variation, which is essential to designing an efficient monitoring program for detection of long-term trends. In addition to addressing status and trends, this monitoring will establish a foundation for tracking the effectiveness of management actions - another category of the Delta RMP core management questions.

Sources, Pathways, Loadings and Processes

SPLP1. Which sources, pathways and processes contribute most to observed levels of methylmercury in fish?

SPLP1.A. What are the loads from tributaries to the Delta (measured at the point where tributaries cross the boundary of the legal Delta)?

A mass budget for methylmercury in the Delta is a critical element of the TMDL. The mass budget provides essential context for understanding the importance of inputs from discharges and internal sources and processes. Obtaining data to expand and update the dataset on methylmercury inputs to the Delta is a high priority to support TMDL refinement and implementation. Methylmercury export from the Delta is similarly an important component of the mass budget and a high priority information need.

Fish-Water Linkage Analysis
(new priority question articulated by Mercury Subcommittee)

FWLA1. Are there key datasets needed to strengthen the technical foundation of contaminant control programs?

Another priority question that will be addressed by this workplan relates to the linkage analysis discussed in the previous section, which is a key element of the technical basis for the TMDL. This question was not articulated in the core management questions and assessment questions established by the Steering Committee, but was nevertheless identified as a priority by the Mercury Subcommittee. Additional data on methylmercury in water is one of the key datasets needed to strengthen the technical foundation of the TMDL.

Secondary Assessment Questions

ST1. What are the status and trends in ambient concentrations of methylmercury and total mercury in sport fish and water, particularly in subareas likely to be affected by major existing or new sources (e.g., large-scale restoration projects)?

ST1.B. How are ambient levels and trends affected by variability in climate, hydrology, and ecology?

The time series for methylmercury in fish and water that are created to answer the primary assessment questions will also be influenced by variation in climate, hydrology, and ecology, and will provide information on the role of these factors. For example, the first two years of monitoring have already spanned the end of a prolonged drought and a high flow year, providing an opportunity to examine the impact of extreme variation in flow on methylmercury concentrations in fish and water.

Sources, Pathways, Loadings and Processes

SPLP1. Which sources, pathways and processes contribute most to observed levels of methylmercury in fish?

SPLP1.B. How do internal sources and processes influence methylmercury levels in fish in the Delta?

SPLP1.C. How do currently uncontrollable sources (e.g., atmospheric deposition, both as direct deposition to Delta surface waters and as a contribution to nonpoint runoff) influence methylmercury levels in fish in the Delta?

Forecasting Scenarios

FS1. What will be the effects of in-progress and planned source controls, restoration projects, and water management changes on ambient methylmercury concentrations in fish in the Delta?

These secondary assessment questions relating to Sources, Pathways, Loadings, and Processes and Forecasting Scenarios for this initial phase of methylmercury monitoring relate to one of the major control studies called for in the TMDL: an effort to combine modeling, field data, and laboratory studies to evaluate the potential effects of water project operational changes on methylmercury in Delta channels. The Department of Water Resources (DWR) is currently developing two mathematical models, one each for the Delta and Yolo Bypass, that will allow testing of various water management scenarios (DiGiorgio et al. 2016). These models will be useful in addressing this set of Delta RMP management questions. The opportunity to inform these models, which are being developed with a considerable investment of funding from the California Department of Water Resources (DWR), makes monitoring to address these questions a near-term priority for the Delta RMP. The water monitoring included in this workplan will generate data that are valuable for verifying trends and patterns predicted by the methylmercury models.

Approach

Fish Sampling

Design	7 fixed sites (Figure 1), largemouth bass only - adding a site in the West Delta in this round
Key Indicator	Annual average methylmercury in muscle fillet of 350 mm largemouth bass (or similar predator species), derived through analysis of 16 individual bass or other predator species at each location
Parameters	Total mercury*, Total length, Fork length, Weight, Sex, Moisture, Estimated age
Frequency	Annual
Schedule	Monitor through 2025 and then re-evaluate. Sample in summer or early fall.
Co-location	Water methylmercury (MeHg) and mercury (Hg) Other water parameters
Contractors	SFEI (design, data management, reporting), MLML (sample collection, chemical analysis, reporting)
Coordination	DWR, USGS (sampling of flow monitoring stations)

* Total mercury measured as proxy of methylmercury because methylmercury comprises more than 90% of the total mercury in fish.

Summary of Results to Date

Results from the first year of DRMP methylmercury monitoring are presented in the Year One Data Report (Davis et al. 2018). The report provides details on the sample collection and processing, chemical analysis, quality assurance, and the results. Highlights of the results are briefly discussed here.

Results from the first round of DRMP fish monitoring are presented in Figure 2, with data from prior fish sampling in or near these stations provided for context. Time series with more than three observations are available for four of the six locations. The existing time series are characterized by a high degree of inconsistency in locations, species, and sampling approach over time, highlighting the need to build a consistent dataset for trend evaluation. The data do suggest a preliminary answer to management question 1A. The data suggest a decline in concentrations at the San Joaquin River at Vernalis over the period of record, while concentrations appeared to be stable at the other three locations. Therefore, the data give a

preliminary indication that trends do vary among the Delta subareas. Additional rounds of consistent sampling are needed to confirm this preliminary interpretation.

Water Sampling

Design	8 fixed sites (Figure 1) - adding sites for export from the Delta in this round (Mallard Island in the west Delta and the Delta Mendota Canal for a water project export site)
Key Indicator	March-October average total (unfiltered) methylmercury at each location
Parameters	• Total (unfiltered) methylmercury • Filtered methylmercury • Unfiltered total mercury • Filtered total mercury • Total suspended solids • Volatile suspended solids • Chlorophyll-a • Dissolved organic carbon (field filtered) • Total organic carbon **Field measurements:** • Dissolved oxygen • pH • Specific conductance
Frequency	8 events per year (6 bi-monthly events + 2 storm or winter events)
Schedule	Monitor through 2020 and then re-evaluate
Co-location	Sport fish sampling (at 7 of the sites, excluding Delta Mendota Canal) Other water parameters
Coordination	DWR, USGS (sampling of flow monitoring stations)

Summary of Results to Date

Results for March-October average total (unfiltered) methylmercury at each location for the first year of sampling are briefly summarized here. Data for the other water parameters are presented in the Year One Data Report (Davis et al. 2018).

Figure 3 presents long-term time series of March to October annual averages of total unfiltered MeHg concentrations for Delta RMP sites. Sacramento River concentrations have remained

constant with good agreement between historic data and current data. Cache Slough 2016 concentration was lower than what was reported previously but the 2017 concentration was within historic ranges. No historic data are available for Little Potato Slough. Middle River MeHg concentrations were highly variable with 2016–17 concentrations within the range of historic data. The San Joaquin River 2016 MeHg concentration was lower than previously reported values. However, the 2017 measurement was the highest concentration ever reported for this site.

Data Quality

The measurement quality objectives (MQOs) for measurements of methylmercury and mercury in fish and water are shown in Appendix 1. These MQOs are the same as MQOs used in mercury studies throughout California, with statewide fish monitoring by the Surface Water Ambient Monitoring Program as a prominent example. The MQOs generally call for indices of accuracy and precision to be within 25% to 30% of expected values. Data of this quality are routinely used for determinations of impairment and trend detection throughout the state and the country. The variance attributable to the analytical process is one of the contributors to the overall variance observed in the data. This variance is therefore accounted for in the power estimates provided in the next section.

Power to Detect Long-term Trends - Fish Sampling

The power to detect interannual trends in largemouth bass mercury on a per site basis was evaluated using existing data. Even the best existing time series for the Delta have low statistical power to detect trends due to infrequent sampling and varying sampling designs of studies performed over the years (Figure 2). One of the goals of the initial phase of Delta RMP fish mercury monitoring is to obtain robust information on interannual variation to support future power analysis. As part of the mercury proposal for FY 2017/2018 we conducted a power analysis on the small amount of information presently on hand. Appendix 2 provides the methods and details on the results. This analysis will be updated after a few years of new data have accumulated.

Power analysis summary

Power for trend detection at a single site based on grand mean estimates of observed variance across sites. Pink shading indicates scenarios with greater than 80% power.

		10 Years		20 Years		30 Years	
Trend	N Fish/Yr	Annual	Biennial	Annual	Biennial	Annual	Biennial
0.010 ppm/yr	12	0.11	0.09	0.20	0.15	0.40	0.27
0.020 ppm/yr	12	0.13	0.13	0.44	0.27	0.81	0.60
0.030 ppm/yr	12	0.21	0.17	0.69	0.45	0.99	0.85
0.040 ppm/yr	12	0.29	0.19	0.88	0.61	1.00	0.98
0.010 ppm/yr	16	0.21	0.19	0.33	0.27	0.55	0.44
0.020 ppm/yr	16	0.27	0.24	0.65	0.46	0.93	0.77
0.030 ppm/yr	16	0.36	0.32	0.86	0.64	1.00	0.96
0.040 ppm/yr	16	0.47	0.36	0.97	0.82	1.00	1.00

These preliminary results indicate that increasing the number of fish per site would be effective in increasing power. With 16 fish per site and annual sampling, 80% power would be expected for several of the 20-year scenarios. Beginning with year 2 (FY 2017/2018) the design for fish monitoring was therefore being modified to include 16 fish per site. The monitoring results for the San Joaquin at Vernalis suggest that trends of up to 0.040 ppm/yr are possible. The results highlight the importance of initiating consistent time series.

Power Analysis - Water Sampling

Not applicable. The primary objectives of the water sampling are to strengthen the linkage analysis and support model development. The water monitoring is not intended as a tool for long-term trend monitoring.

Reporting/Deliverables

Deliverable	**Due Date**
Draft Data Report on Year 2 (FY 17/18) Provisional FY17/18 dataset for review by TAC	December 2018
Final Data Report on Year 2 (FY 17/18) Final FY17/18 data upload to CEDEN	March 2019
Draft Data Report on Year 3 (FY 18/19) Provisional FY18/19 dataset for review by TAC	December 2019*
Final Data Report on Year 3 (FY 18/19) Final FY18/19 dataset upload to CEDEN	March 2020*

*The dates for these deliverables may be moved up, and only include partial year data, in order to provide timely information to inform the revision of the Central Valley Mercury TMDL.

Budget

	Actual	Actual	Old Plan	Proposed: 10 water events	Proposed: 9 water events	Selected: 8 water events	Planned	Planned
Fiscal Year	2016/17	2017/18	2018/19	2018/19	2018/19	2018/19	2019/20	2020/21
Fish Sampling Year	2016	2017	2018	2018	2018	2018	2019	2020
Fish								
Bass Monitoring at Six Sites: Sampling and Analysis	$45,344	$51,804	$53,358	$53,358	$53,358	$53,358	$54,959	$56,608
1 Site Add on				$7,521	$7,521	$7,521	$7,747	$7,979
MLML In-Kind	($8,262)	($5,100)	($5,100)	($5,100)	($5,100)	($5,100)	($5,100)	($5,100)
Water								
Water Monitoring at Five Sites, Quarterly: Sampling and Analysis	$65,310							
MLML In-Kind	($12,392)							
Water Monitoring at Six Sites, 8 months: Sampling and Analysis		$152,952	$157,541	$154,703	$154,703	$154,703	$159,344	$164,124
Water 2 site 8 month add on				$51,568	$51,568	$51,568	$53,115	$54,708
Water, 2 winter event, 8 sites				$51,568	$25,784	$0	$53,115	$54,708
MLML In-Kind		($16,700)	($16,700)	($24,900)	($22,410)	($19,920)	($24,900)	($24,900)
Sediment								
Sediment Monitoring at Six Sites, Quarterly: Sampling and Analysis		$29,260	$30,138	$0	$0	$0	$0	$0
MLML In-Kind		($3,200)	($3,200)	$0	$0	$0	$0	$0
Data Management, Oversight, Reporting								
SFEI Data Mgmt and QA Review	$15,000	$19,545	$20,131	$29,930	$29,930	$29,930	$30,828	$31,753
SFEI Oversight and Coordination	$3,000	$5,000	$5,150	$5,150	$5,150	$5,150	$5,305	$5,464
Interpretive Report							$20,000	
Total	$128,654	$258,561	$266,318	$353,798	$328,014	$302,230	$384,412	$375,345
MLML In-Kind	($20,654)	($25,000)	($25,000)	($30,000)	($27,510)	($25,020)	($30,000)	($30,000)
Total Cost to Delta RMP	$108,000	$233,561	$241,318	$323,798	$300,504	$277,210	$354,412	$345,345

Table 1. Sampling schedule for Delta RMP mercury monitoring. The March-October period used for the linkage analysis in the TMDL is indicated in bold font and with a gray background.

Year →	2016						2017						2018						2019						2020					
Fiscal Yr →	FY 16/17												FY17/18												FY18/19					
Month →	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Monitoring element (# of sites sampled)																														
Fish		*6*												*6*													*7*			
Water		*5*			*5*			*5*		*5*						*6*			*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*		
Sediment																*6*			*6*			*6*		*6*						

Year →	2019						2020					
Fiscal Yr →	FY18/19						FY19/20					
Month →	1	2	3	4	5	6	7	8	9	10	11	12
Monitoring element (# of sites sampled)												
Fish								*7*				
Water			*8*	*8*	*8*	*8*	*8*	*8*	*8*	*8*		
Sediment												

	Fish			Water			Sediment		
	Events	Sites	# Samples	Events	Sites	# Samples	Events	Sites	# Samples
FY16/17	1	6	6	4	5	20	-	-	-
FY17/18	1	6	6	7	6 - 8	54	4	6	24
FY18/19	1	7	7	8	8	64	-	-	-
FY19/20	1	7	7	10	8	80	-	-	-

Figure 1. Planned sampling sites for methylmercury in FY18/19.

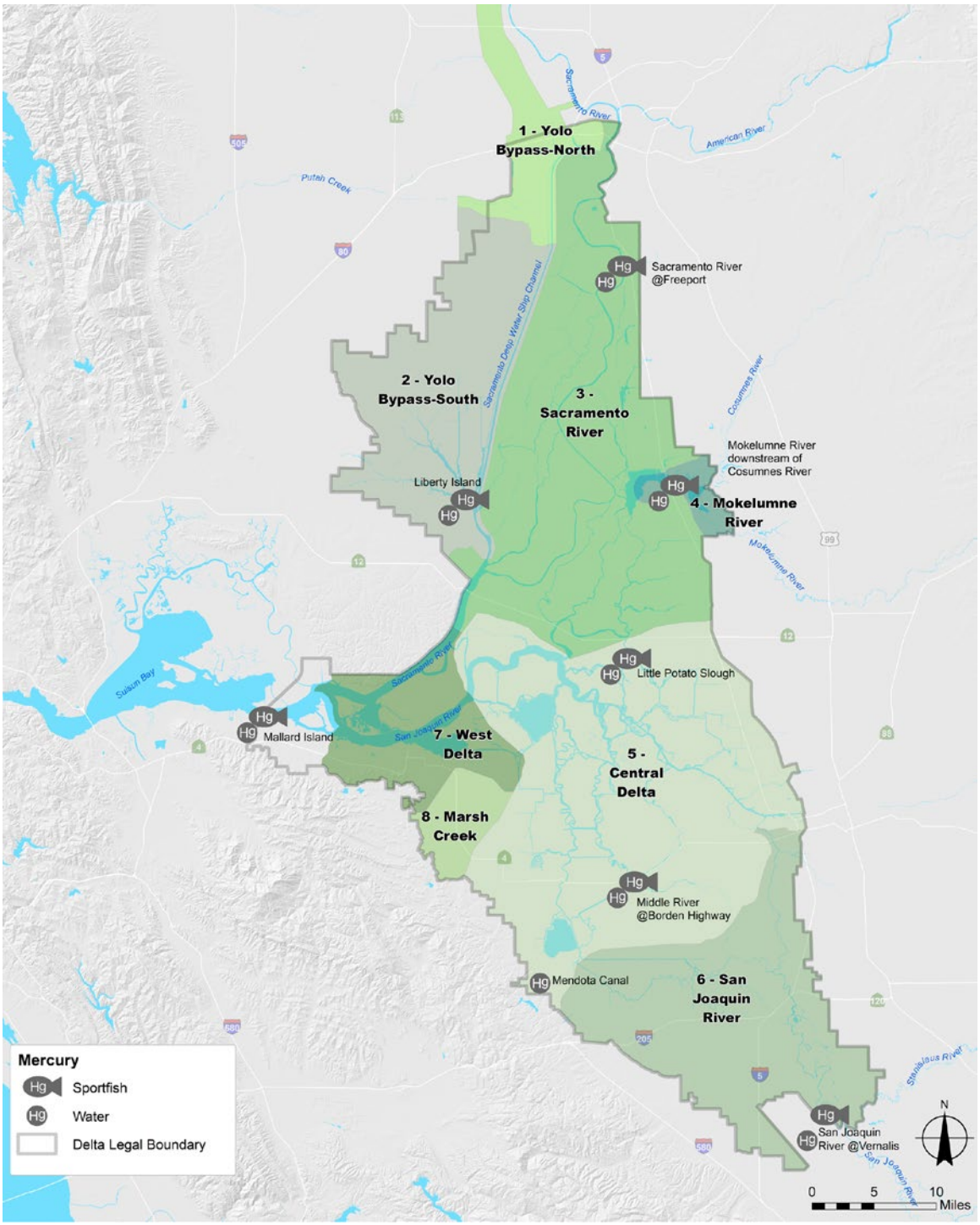


Figure 2. Long-term time series of mean mercury (ppm wet weight) in black bass for Delta RMP stations and nearby stations sampled historically. Details on following page.

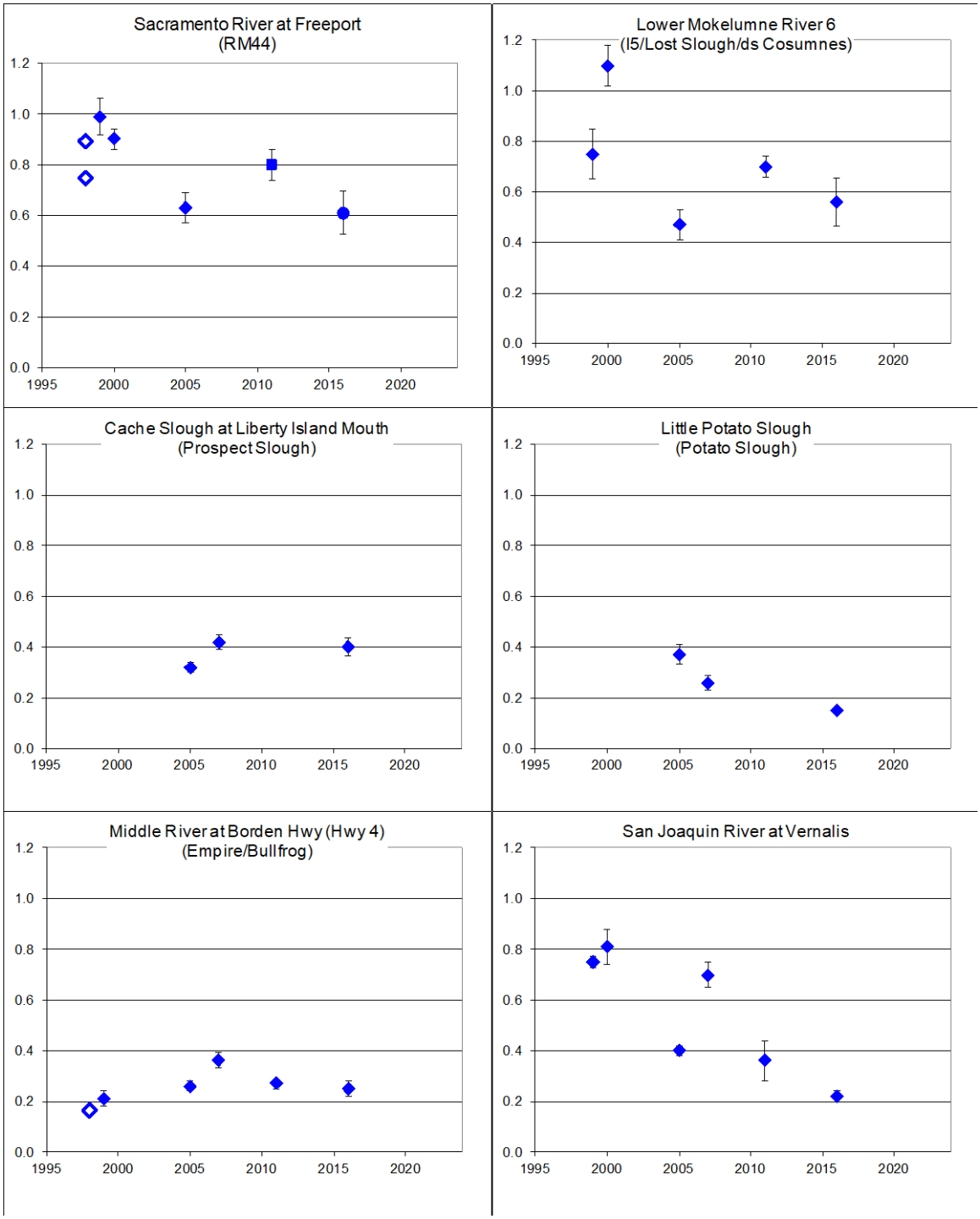


Figure 2 Details

Points generally show 350 mm length-adjusted means (exceptions to this noted in plot details below) and error bars indicate two times the standard error. Filled symbols indicate 350 mm length-adjusted means, hollow symbols indicate individual composite samples or arithmetic means when the station did not have a significant length:mercury correlation. Diamonds indicate largemouth bass; squares are spotted bass; circles are smallmouth bass. Data sources: Delta RMP - 2016; the Surface Water Ambient Monitoring Program (Davis et al. 2013) - 2011; the Fish Mercury Project (Melwani et al. 2009) - 2005-2007; the CALFED Mercury Project (Davis et al. 2003) - 1999-2000; the Delta Fish Study (Davis et al. 2000) - 1998; and the Sacramento River Watershed Program (2002) - 1998.

Sacramento River at Freeport
Stations - Freeport: 2016; RM44: All other years
Statistics - Individual composite results: 1998; 350 mm length adjusted mean: all other years

Lower Mokelumne River 6
Stations - Lower Mokelumne River 6: 2016; Mokelumne River near I-5: 2011; Lost Slough: 2005; Mokelumne River downstream of the Cosumnes River: 1999, 2000

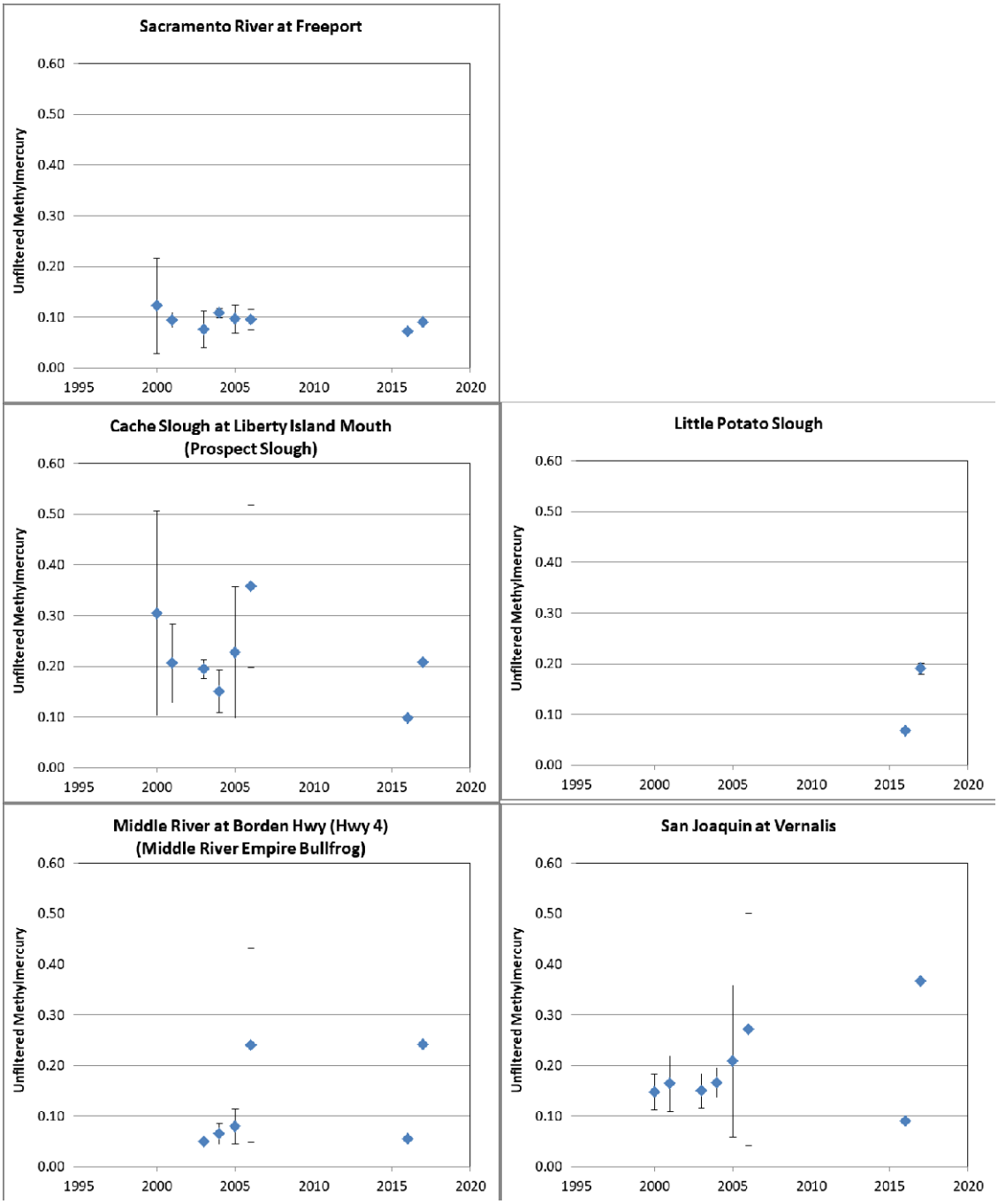
Cache Slough at Liberty Island Mouth
Stations - Cache Slough at Liberty Island Mouth: 2016; Prospect Slough: 2005, 2007

Little Potato Slough
Stations - Little Potato Slough: 2016; Potato Slough (aka San Joaquin River at Potato Slough): 2005, 2007

Middle River at Borden Hwy (Hwy 4)
Stations - Middle River at Borden Hwy (Hwy 4): 2016; Middle River near Empire Cut: 2011; Middle River at Bullfrog: 1998, 1999, 2007; Middle River at HWY 4: 2005
Statistics - Individual composite result: 1998; 350 mm length adjusted mean: all other years

San Joaquin River at Vernalis
Stations - Same station all years

Figure 3. Annual mean aqueous unfiltered methylmercury concentration at each Delta RMP monitoring station sampled from August 2016 through April 2017. Plots based on March-October data.



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Materials for Agenda Item 11

OCTOBER 2018

DELTA REGIONAL MONITORING PROGRAM

Pathogen Study Final Report

[OCTOBER 2018 DRAFT FOR STEERING COMMITTEE DISTRIBUTION]

DRAFT

Prepared by

LARRY WALKER ASSOCIATES

Acknowledgements

The contributions of the following work groups and individuals, who contributed to the development of the Pathogen Study and preparation of this document, are gratefully acknowledged:
Central Valley Clean Water Association
Central Valley Drinking Water Policy Workgroup
California Department of Water Resources, Municipal Water Quality Investigations Program
City of Sacramento Department of Utilities
Sacramento Regional County Sanitation District

City of Sacramento Department of Utilities:
Elissa Callman

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Delta RMP Pathogen Study Final Report

1. INTRODUCTION

The Delta Regional Monitoring Program (RMP) Pathogen Study (Pathogen Study) was designed to fulfill the dual purposes of characterizing ambient conditions for pathogens (*Cryptosporidium* and *Giardia*) throughout the Sacramento-San Joaquin Delta (Delta) and satisfying regulatory requirements. The Central Valley Regional Water Quality Control Board (Water Board) adopted a Basin Plan Amendment to establish a Drinking Water Policy (Basin Plan Amendment) to protect source water quality on July 26, 2013.[1] The Basin Plan Amendment added a narrative water quality objective for *Cryptosporidium* and *Giardia* to the Basin Plan, with associated implementation and monitoring provisions, as well as language addressing other constituents of potential concern to drinking water. The Basin Plan Amendment recommends that a study be performed to "characterize ambient background conditions and potential sources to be used when and if exceedance of a trigger occurs."

The Monitoring Design Summary[2] describes the two year pathogen monitoring study developed by the Central Valley Drinking Water Policy Workgroup (Workgroup) in coordination with the Delta RMP. The study coordinated water agency intake sample collection for the United States Environmental Protection Agency (USEPA) Long Term 2 Enhanced Surface Water Treatment Rule (LT2) between April 2015 and April 2017 with ambient sample collection. The Delta RMP collected ambient samples at twelve locations through in-kind field support by the Municipal Water Quality Investigations (MWQI) section of the Department of Water Resources (DWR), with funding from the Delta RMP for analytical services, and in-kind contributions from Workgroup members to oversee sample collection and data assessment.

The study was phased to perform an initial assessment in the first year of characterization data and then a more targeted Delta subarea evaluation of infectibility, source tracking, hydrodynamics, and decay/ growth in the second year. However, monitoring results were all below threshold values in the first year and targeted studies were not necessary during the second year.

This final report addresses the Basin Plan requirements and presents the results of ambient and drinking water intake monitoring in the context of the Delta RMP assessment questions that were developed prior to this study.

1.1 Basin Plan Requirements

The Basin Plan specifies a narrative objective for *Cryptosporidium* and *Giardia* to protect the public water system component of the MUN beneficial use, with the goal of maintaining existing levels of pathogens at public water system intakes below levels of concern. In accordance with the USEPA LT2, public water systems are required to monitor for *Cryptosporidium* at their intakes (USEPA, 2006).[3] The monitoring results are used to implement the bin classification for the water system, which prescribes the level of treatment that the system must provide depending on the bin level for the raw water supply. To assure that *Cryptosporidium* levels at public water

[1] https://www.waterboards.ca.gov/rwqcb5/water_issues/drinking_water_policy/

[2] Delta Regional Monitoring Program. *Monitoring Design Summary***.** Prepared for Delta RMP Steering Committee. November 3, 2014. *Revised June 16, 2015*

[3] LT2 guidance allows for analysis of intake samples using either USEPA Method 1622 or 1623. Method 1622 is for just *Cryptosporidium*, while Method 1623 includes *Giardia* also. The LT2 rule does not require monitoring for *Giardia,* and only *Cryptosporidium* data need to be submitted.

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systems stay at their current bin classifications, the Basin Plan specifies "triggers" based on 80% of the LT2 bin classification thresholds.

Since all drinking water intake locations within or immediately upstream of the Delta[4] are currently classified as bin 1 (maximum running annual average <0.075 oocysts/L), the trigger value (80% of the bin 2 level) is 0.06 oocysts/L (maximum running annual average). A maximum running annual average above the trigger value at a drinking water intake prompts proactive actions to investigate potential contributors to the change in bin level.

If a maximum running annual average at an ambient location exceeds the trigger value, a follow-up study would only occur if a trigger value exceedance also occurred at the nearest drinking water intake or if other compelling evidence was obtained (e.g., increasing trend, extreme value). The Basin Plan Amendment specifies that a one-time special study would be undertaken by the RMP, or through other coordinated efforts by stakeholders, that would characterize ambient background concentrations and potential sources to be used when and if a trigger is exceeded. The Pathogen Study was designed to fulfill the Policy actions that would be undertaken by a trigger. **Table 1** outlines the components specified by the Basin Plan Amendment and indicates how they were addressed by the Pathogen Study.

The Monitoring Design Summary implements the Basin Plan Figure IV-1 trigger response and identifies several possible tools that can be used for a triggered study. During the RMP Pathogen Study, the Pathogen Workgroup compiled the data and compared drinking water intake rolling twelve-month averages to the trigger value. Because the water intake data are compiled by other agencies, the Pathogen Workgroup also evaluated ambient data against the trigger values. The trigger response would have involved data and source assessments and associated decision steps: 1) data review, 2) assessment, and 3) investigation. The results are discussed in subsequent sections of this final report; however, no follow-up studies were triggered during the Pathogen Study.

Table 1. Drinking Water Policy Basin Plan Amendment Study Components

Component	Addressed by RMP Pathogen Study
Literature review to identify available source information	Literature Review (Section 1.1.1)
Continued monitoring at existing public water system intakes	Drinking Water Intake Monitoring (Sections 2.1, 3.1)
Monitoring at several ambient locations that will be identified as sites that integrate the pathogen sources where historic pathogen data are unavailable	Ambient Monitoring (Sections 2.2, 3.2)
Monitoring at several representative discharge locations, if representative pathogen concentrations are not available or if coordinated data are necessary	Not required – No trigger
Hydrodynamic and particle tracking models to simulate the transport of pathogens from potential sources to public water system intakes	Not required – No trigger
If needed, focused studies to identify the viability and fate and transport of *Cryptosporidium*.	Not required – No trigger

[4] With the exception of Davis/Woodland, which does not have a current bin level classification.

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1.2 Literature Review

Pathogenic protozoa such as *Cryptosporidium* and *Giardia* are unicellular parasitic microorganisms that exist in two life stages, either living within a host or as spores that can survive outside of a host. Protozoa can only replicate inside of a host, but can survive and be transmitted from host to host in the form of oocysts or cysts. Spore formation protects protozoa from some environmental stresses, such as extreme temperatures; prolonged periods without food, water, or oxygen; and some harmful chemicals.

1.2.1 Sources

Cryptosporidium and *Giardia* can infect and be transmitted between humans, domestic animals and wildlife. Protozoan pathogens are shed in fecal matter and can enter the water supply either through direct deposition or by transport from land to nearby water bodies. Sources of protozoan pathogens may include treated wastewater effluent, urban stormwater discharge, agricultural runoff, wildlife sources, and human water-contact recreation.

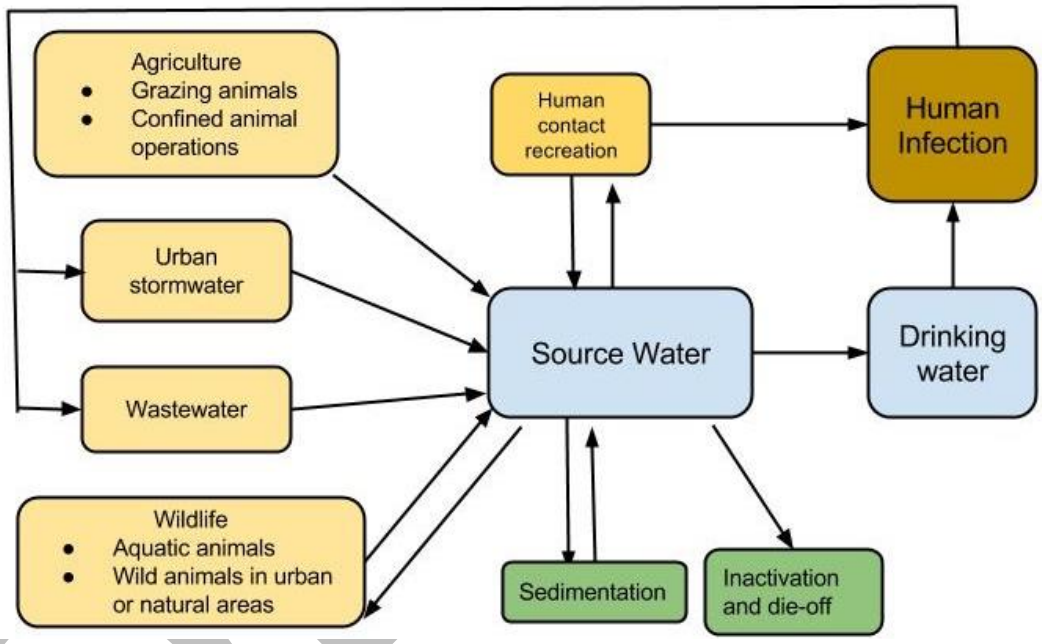

Figure 1. Sources and Fate of *Cryptosporidium* and *Giardia*

1.2.2 Environmental Fate

Cryptosporidium oocysts and *Giardia* cysts are robust, capable of surviving in the environment under unfavorable conditions for long time periods (Carey et al., 2004). Their persistence in surface waters is influenced by temperature, UV exposure, and removal from the water column by sedimentation processes.

In general, microorganisms survive longer in the environment at lower temperatures. There is some indication that temperature within narrow environmental ranges may not be a major factor in the survival of protozoan pathogens. One study used a factorial design to investigate the combined effect of environmental conditions on oocyst survival, and concluded that *Cryptosporidium* oocyst survival was stable within a range of cold temperatures (from 4°C to 18°C) (Freire-Santos et al., 2000). Another study determined that inactivation of *Cryptosporidium* oocysts increased in direct proportion to temperatures between 4°C and 30°C (Walker et al., 2001).

Exposure to UV light from sunlight is detrimental to all types of pathogens. Protozoan pathogens have been found to be more resistant to UV than bacteria or viruses, but are still significantly impacted by exposure to sunlight (Ferguson et al., 2003). Brookes et al. modeled oocyst inactivation by UV, finding that inactivation followed an exponential decay function (Brookes et al., 2004). The extinction coefficient for UV light in a waterbody is important for determining the timescale for UV inactivation – Brooks et al. state that UV inactivation of *Cryptosporidium* can vary widely depending on the location of the oocysts in the water column and the extinction coefficient for UV light.
Sedimentation is an important removal mechanism in low-flowing aquatic environments (Dai and Boll, 2006).

1.2.3 Viability and Infectivity

USEPA Method 1623 reports cysts or oocysts by examination of size, shape and fluorescence observed under a microscope; however, the presence of cysts or oocysts does not indicate whether they are viable. Not all of the cysts or oocysts in water are viable, and subsequently capable of causing an infection. One study using a method for assessing the viability of oocysts in wastewater found that only 40% of the oocysts in the raw untreated sewage entering a treatment plant were infectious, and this number decreased after treatment (Harwood et al., 2005).
The current body of scientific literature points to considerable uncertainty about the infectivity of protozoan pathogens. Issues influencing infectivity include variability in host susceptibility, response at low oocyst doses, and relative infectivity and occurrence of different *Cryptosporidium* or *Giardia* isolates. Infectivity studies in humans have been conducted using healthy adult volunteers. Chappell and colleagues at the University of Texas assessed infection following dosing using varying amounts of three different *C. parvum* isolates in three separate studies (Okhuysen et al. 1999). Data indicated differences in infectivity among the isolates:

- *C. parvum* TAMU (from an infected horse) was the most infectious, with 67% of volunteers infected when dosed with 10 oocysts, and 100% infected when dosed with 100 oocysts.
- *C. parvum* Iowa (derived from calf) was less infectious, with 40% of volunteers infected when dosed with 30 oocysts, and 100% infected with does with 1,000 oocysts.
- *C. parvum* UCP (derived from calf) was the least infections, with 60% of volunteers infected when dosed with 500 oocysts, and 100% infected with dosed with 10,000 oocysts.

Other human volunteer studies have confirmed the ranges of infectivity found in the 1999 study. A 2006 study by Chappell and colleagues used a *C. hominis* isolate (TU502) and found that 40% of subjects were infected by a dose of 10 oocysts, 71% were infected by a dose of 100 oocysts, and 75% were infected by a dose of 500 oocysts (Chappell et al. 2006). An additional study using a different isolate found that a dose of 100 oocysts infected 75% of volunteers, with higher doses (300, 1000, and 3000) resulting in similar or lower percentages of infection (60%, 67%, and 75%) (Okhuysen et al. 2002).

1.3 Delta RMP Pathogen Study Purpose

The Pathogen Study was designed to fulfill the Basin Plan Amendment actions that would be undertaken if a trigger value was exceeded. The RMP assessment questions for the Pathogen Study were designed to fulfill the Policy requirements, as outlined in **Table 2**.

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Table 2. Delta RMP Assessment Questions for the Pathogen Study

Assessment Question Type	Number	Assessment Question
Status and Trends (ST)	**ST 1**	Are current pathogen levels supportive of the municipal drinking water quality beneficial use as described in the Basin Plan?
	A.	Are the current pathogen levels for each Delta water intake and those immediately upstream (i.e., Sacramento Area) different than the previous LT2 sampling? Are any drinking water intakes reclassified into a higher bin level?
	B.	Are Basin Plan trigger values exceeded?
Sources, Pathways and Loading (SPLP)	**SPLP 1**	Can any changes in bin level be attributed to an identifiable event, condition, or changes in a source?
	A.	What are the concentrations in ambient waters upstream or downstream from intakes with observed changes to bin levels?
	B.	What is the influence of sources (agriculture, wastewater treatment plants, urban runoff, upstream tributary, natural, recreation, and other) on pathogen levels at drinking water intakes?
	C.	Are there new discharges or changes in sources or conditions that could explain the change in bin level compared to previous LT2 monitoring?
	SPLP 2	What is the viability and infectivity of pathogens at drinking water intakes?
	A.	What percentage of *Cryptosporidium* found in ambient waters and source waters can cause infection?
	SPLP 3	What are the factors affecting decay and growth rates and can they be quantified and characterized for the purpose of modeling?
	A.	Is there recent research or literature on the environmental fate of *Cryptosporidium* and *Giardia* that can be used to develop decay/growth rates in models?
	B.	What are the observed changes in *Cryptosporidium* and *Giardia* concentrations as a pulse of ambient water or source water moves through the watershed and Delta?

2. MONITORING DESIGN

The Monitoring Design Summary describes the approach for the Pathogen Study. Drinking Water intake and Ambient locations are shown in **Figure 2**. As described in the following sections, sampling for *Cryptosporidium* and *Giardia* occurred monthly for two years at each monitoring location.

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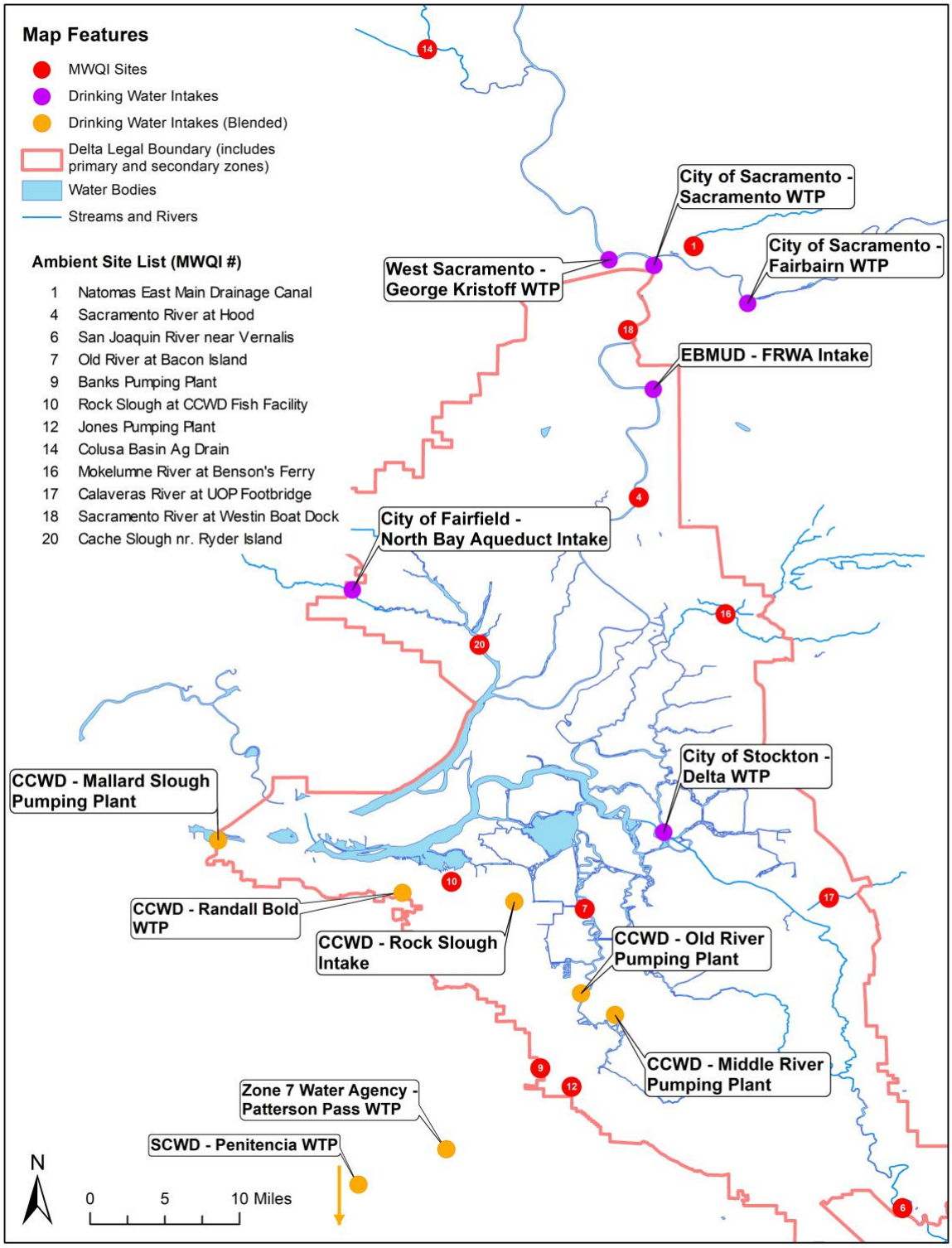

Figure 2. Locations of Ambient and Drinking Water Intake Locations

2.1 Water Intake Sample Collection

As part of the second round of the LT2, water supply agencies collected *Cryptosporidium* and *Giardia* samples monthly for two years in the source waters at treatment plant intakes[5] starting in April 2015. The water supply agencies that contributed data for the RMP Pathogen Study are shown in **Table 3**. The drinking water intake locations are shown in **Figure 2**. The City of Davis/Woodland/UC Davis – Woodland Davis Clean Water Agency (WDCWA) Regional Water Treatment Facility (WTF), located upstream of the Sacramento urban area, did not contribute data for this study. The WDCWA became fully operational in June 2016, and is in the process of preparing a 2-Year sampling and monitoring plan as required for Bin classification on a 6-year cycle. Sampling is anticipated to begin by September 2018.

In some cases, the treatment plant intakes include a blend of multiple "raw" water sources. These data will be used to determine if the bin levels[6] assigned after the first round of monitoring are still valid or need to be revised. In addition, data from the second round of monitoring was also used to evaluate conditions relative to the Basin Plan trigger levels (80% of bin level). The bin levels and Basin Plan triggers are shown in **Table 4**.

Table 3. Water Supply Agencies Contributing Drinking Water Intake Data

Agency and Intake Facility	Source Water Description	Location Description
West Sacramento – George Kristoff Water Treatment Plant (WTP)	Sacramento River	Upstream of Sacramento urban area
City of Sacramento – Fairbairn WTP	American River	Within Sacramento urban area
City of Sacramento – Sacramento WTP	Sacramento River	Within Sacramento urban area
East Bay Municipal Utilities District (EBMUD) – Freeport Regional Water Authority (FRWA) Intake	Sacramento River	Downstream of Sacramento urban area, within Delta
City of Fairfield – North Bay Aqueduct Intake	Barker Slough	North Delta water with some local watershed runoff in wet season
City of Stockton – Delta WTP	San Joaquin River	Within eastern Delta
Contra Costa Water District (CCWD) – Randall Bold WTP	Western Delta/Los Vaqueros Reservoir	Within western Delta, blended intakes
Zone 7 Water Agency – Patterson Pass WTP	South Bay Aqueduct	100% Delta water in South Bay Aqueduct
Santa Clara Valley Water District (SCVWD) – Penitencia WTP	South Bay Aqueduct	Blend of South Bay Aqueduct and Lake Del Valle water

[5] LT2 Source Water Monitoring Guidance specifies that "LT2 Rule monitoring is intended to assess the mean Cryptosporidium level in the influent to drinking water plants that treat surface water or ground water under the direct influence (GWUDI) of surface water. PWSs are required to collect source water samples for the LT2 Rule from each plant intake prior to chemical treatment"
http://www.epa.gov/ogwdw/disinfection/lt2/pdfs/guide_lt2_swmonitoringguidance.pdf

[6] http://www.epa.gov/ogwdw/disinfection/lt2/pdfs/fs_sw_monitoring_fs_sch_1-3_final.pdf

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Table 4. LT2 Bin Levels and Basin Plan 80% Triggers

LT2 Program		Basin Plan
Bin Classification	**Maximum Running Annual Average[a] (oocysts/L)**	**Maximum Running Annual Average 80% Trigger (oocysts/L)**
1	<0.075	0.06
2	0.075 to <1.0	0.80
3	1.0 to <3.0	2.40

Note: [a] The term used in the regulation is "mean *Cryptosporidium* bin concentration." If an agency collects at least 48 monthly samples, they can average all samples collected. The guidance specifies that agencies can use the maximum average of 12 consecutive samples if fewer than 48 samples are collected (USEPA, 2006).

2.2 Ambient Sample Collection

Ambient sampling was performed by the DWR MWQI Program, as described in the Monitoring Design Summary. The samples were analyzed by analytical laboratories certified for USEPA Method 1623 for *Cryptosporidium* and *Giardia*. The primary laboratory, BioVir, performed most all analyses and the secondary laboratory, Eurofins, analyzed inter-laboratory quality control samples.

Ambient locations are co-located with existing MWQI sites as shown in **Table 5**. Some sites are upstream of the Delta but could influence water quality at the drinking water intakes or are representative of larger areas with the same land uses. **Figure 2** shows the ambient sampling locations, alongside the drinking water intakes.

Samples were collected monthly by MWQI, during their established sample runs occurring the first full work-week of each month. The sampling frequency matched the LT2 intake monthly sampling frequency.

Table 5. Ambient Monitoring Locations

Location ID	Description	Source(s) Represented	Rationale for Inclusion
MWQI #14	Colusa Basin Ag Drain	Agriculture	Source representation
MWQI #1	Natomas East Main Drainage Canal	Stormwater, Agriculture	Source representation
MWQI #18	Sacramento River at Westin Boat Dock	Stormwater, Combined Sewer System	Proximity to intakes
MWQI #4	Sacramento River at Hood	Stormwater, Wastewater	General characterization
MWQI #20	Cache Slough near Ryder Island	Wetlands, Stormwater, Wastewater	Source Representation
MWQI #16	Mokelumne River at Benson's Ferry		Input to Delta
MWQI #17	Calaveras River at UOP Footbridge	Stormwater	Source representation
MWQI #10	Rock Slough at CCWD Fish Facility		General characterization
MWQI #7	Old River at Bacon Island		General characterization
MWQI #9	Banks Pumping Plant		Export from Delta
MWQI #12	Jones Pumping Plant		Export from Delta

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Location ID	Description	Source(s) Represented	Rationale for Inclusion
MWQI #6	San Joaquin River near Vernalis		Input to Delta

3. RESULTS

The results for the Pathogen Study intake and ambient monitoring are presented in the following sections, as outlined in the Monitoring Design Summary. Complete results for Ambient and Intake monitoring are included in **Appendix A**. The general conclusions, and assessment of how the study addressed the RMP assessment questions, are included in Section 4.

In general, data confirmed that the Basin Plan trigger values (0.06 oocysts/L) for *Cryptosporidium* were not exceeded at the drinking water intakes during the Pathogen Study period, which included several widespread storm events. The ambient data collected by the RMP supports this finding, though the trigger values are only applicable at the water intake locations. The data are summarized in **Table 6**. **Figure 3** graphically presents both the intake and ambient data combined, showing the ranges of the maximum running annual average concentrations of *Cryptosporidium* and *Giardia*. All calculated running twelve-month averages were well below trigger values. In general, the mainstream Delta locations had fewer detected values of both pathogens relative to the more upstream locations.

The sample collection period included a critically dry year and an above normal wet year, including sample collection immediately after and during widespread rainfall events. While the sample collection frequency is not sufficient to identify statistically significant trends over time, if can help identify critical conditions.

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Table 6. Summary of Drinking Water Intake and Ambient Monitoring Results

Agency/Site	*Cryptosporidium* (oocysts/L)						*Giardia* (cysts/L)					
	n	n Det.	Min.	Max.	Median[a]	Mean[b]	n	n Det.	Min.	Max.	Median[a]	Mean[b]
Drinking Water Intake												
West Sacramento	21	0	<0.1	<0.1	<0.1	0	21	1	<0.1	**0.1**	<0.1	**0.005**
Sacramento Fairbairn	24	0	<0.1	<0.1	<0.1	0	24	9	<0.1	**0.3**	<0.1	**0.06**
Sacramento River WTP	24	1	<0.1	**0.2**	<0.1	**0.008**	24	4	<0.1	**0.2**	<0.1	**0.02**
EBMUD	18	1	<0.1	**0.2**	<0.1	**0.01**	15	1	<0.1	**0.4**	<0.1	**0.03**
Fairfield	24	1	<0.1	**0.2**	<0.1	**0.008**	0	[c]	[c]	[c]	[c]	[c]
Stockton	21	0	<0.1	<0.1	<0.1	0	0	[c]	[c]	[c]	[c]	[c]
CCWD	25	0	<0.1	<0.1	<0.1	0	14	2	<0.1	**0.2**	<0.1	**0.02**
Zone 7	18	1	<0.06	**0.07**	<0.1	**0.004**	0	[c]	[c]	[c]	[c]	[c]
SCVWD	19	2	<0.1	**0.1**	<0.1	**0.01**	19	0	<0.1	<0.1	<0.1	0
Ambient												
MWQI #14	22	0	<0.1	<0.1	<0.1	0	22	7	<0.1	2.4	<0.1	**0.22**
MWQI #1	22	2	<0.1	0.1	<0.1	**0.009**	22	14	<0.1	22	0.3	**1.94**
MWQI #18	24	0	<0.1	<0.1	<0.1	0	24	5	<0.1	0.1	<0.1	**0.02**
MWQI #4	24	2	<0.1	0.4	<0.1	**0.02**	24	11	<0.1	0.8	<0.1	**0.15**
MWQI #20	23	0	<0.1	<0.1	<0.1	0	23	0	<0.1	<0.1	<0.1	0
MWQI #16	22	1	<0.1	0.1	<0.1	**0.005**	22	13	<0.1	0.6	0.1	**0.17**

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Agency/Site	*Cryptosporidium* (oocysts/L)						*Giardia* (cysts/L)					
	n	n Det.	Min.	Max.	Median[a]	Mean[b]	n	n Det.	Min.	Max.	Median[a]	Mean[b]
MWQI #17	22	1	<0.1	0.1	<0.1	**0.005**	22	6	<0.1	0.4	<0.1	**0.05**
MWQI #10	24	0	<0.1	<0.1	<0.1	0	24	1	<0.1	0.1	<0.1	**0.004**
MWQI #7	22	0	<0.1	<0.1	<0.1	0	22	6	<0.1	2.3	<0.1	**0.13**
MWQI #9	22	0	<0.1	<0.1	<0.1	0	22	0	<0.1	<0.1	<0.1	0
MWQI #12	22	0	<0.1	<0.1	<0.1	0	22	3	<0.1	0.2	<0.1	**0.02**
MWQI #6	24	2	<0.1	**0.1**	<0.1	**0.008**	24	14	<0.1	**0.9**	**0.1**	**0.13**

Note:
Detected values are indicated in **bold**
[a] Where the median value is non-detect, the median concentration reported as less than the detection limit.
[b] Mean concentration calculated based on arithmetic mean of all sample concentrations, counting non-detects as zero, in accordance with 40 CFR § 141.710(b)(1).
[c] Giardia sample collection and analysis not required for LT2 sample collect

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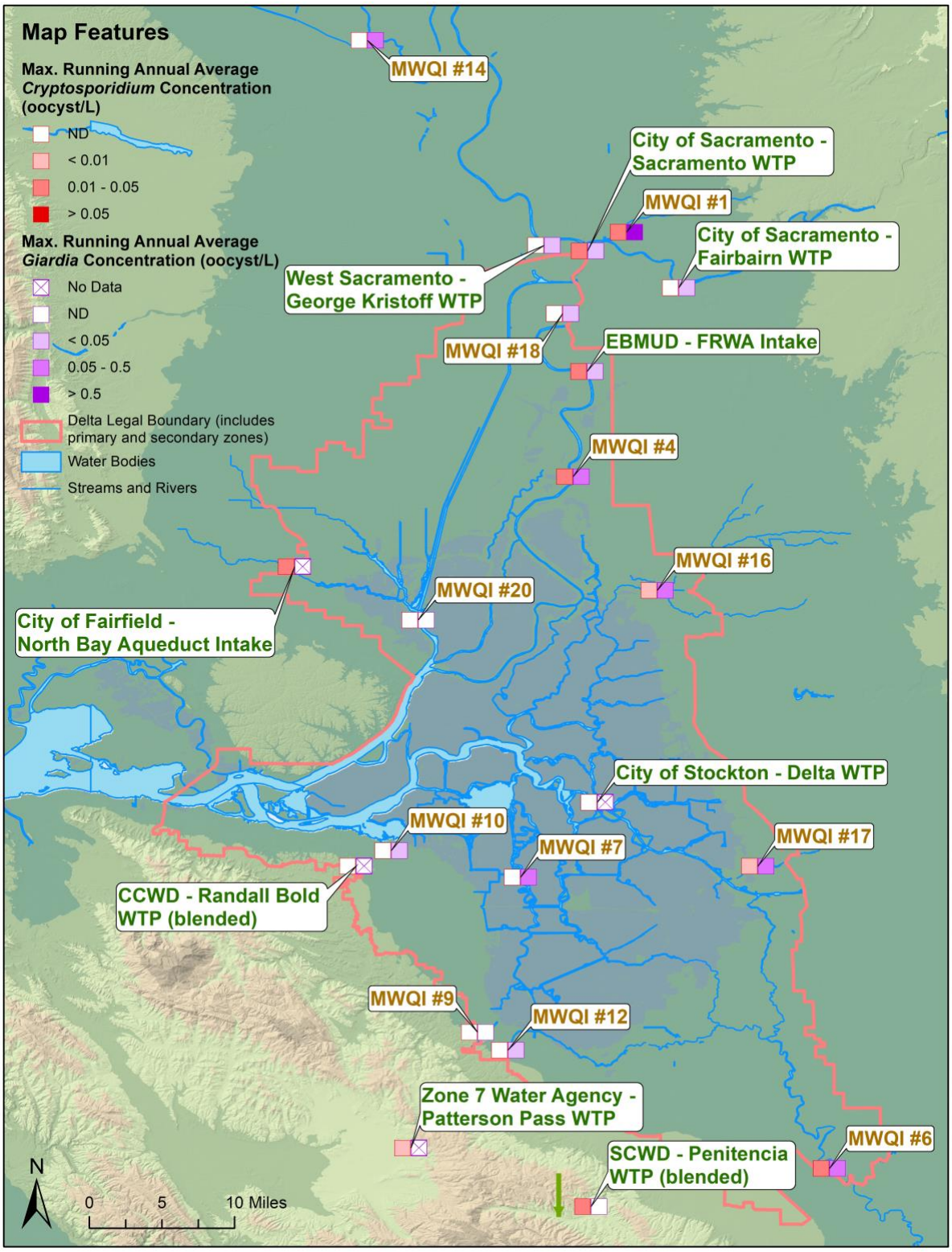

Figure 3. Ambient and Drinking Water Intake *Cryptosporidium* and *Giardia* Maximum Annual Running Annual Average Concentrations

3.1 Drinking Water Intake Results

The historic and current estimated bin levels for the drinking water intakes addressed in this study are presented in **Table 7**. *Cryptosporidium* was infrequently detected at intake locations, and all maximum annual running mean concentrations were well below the trigger value for a trigger exceedance assessment.

To further elucidate any trends due to temporal or spatial conditions, the intake data were assessed using incremental rainfall data (**Figure 4**) and by site (**Figure 5** and **Figure 6**). In general, detections of *Cryptosporidium* and *Giardia* did not correspond with larger rain events but were more prevalent in the fall/early winter periods of both monitoring years. *Cryptosporidium* were only detected in six samples and *Giardia* were detected in seventeen samples over all intake locations, with no one intake location showing a particularly high number of detections or concentration detected.

Table 7. Historic and Current Estimated Bin Levels and Trigger Assessments for Drinking Water Agencies

Water Agency Facility	2007 Bin Level	2015-17 Maximum Running Annual Average	Percent Detected *Cryptosporidium*	Estimated 2015-17 Bin Level	Trigger Exceedance Assessment (if > 0.06)
West Sacramento – George Kristoff WTP	1	0	0%	1	None
City of Sacramento – Fairbairn WTP	1	0	0%	1	None
City of Sacramento – Sacramento WTP	1	0.017	4%	1	None
EBMUD –FRWA Intake	1	0.017	6%	1	None
City of Fairfield – North Bay Aqueduct Intake	1	0.017	4%	1	None
City of Stockton – Delta WTP	1	0	0%	1	None
CCWD – Randall Bold WTP	1	0	0%	1	None
Zone 7 Water Agency – Patterson Pass WTP	1	0.006	6%	1	None
SCVWD – Penitencia WTP	1	0.017	10%	1	None

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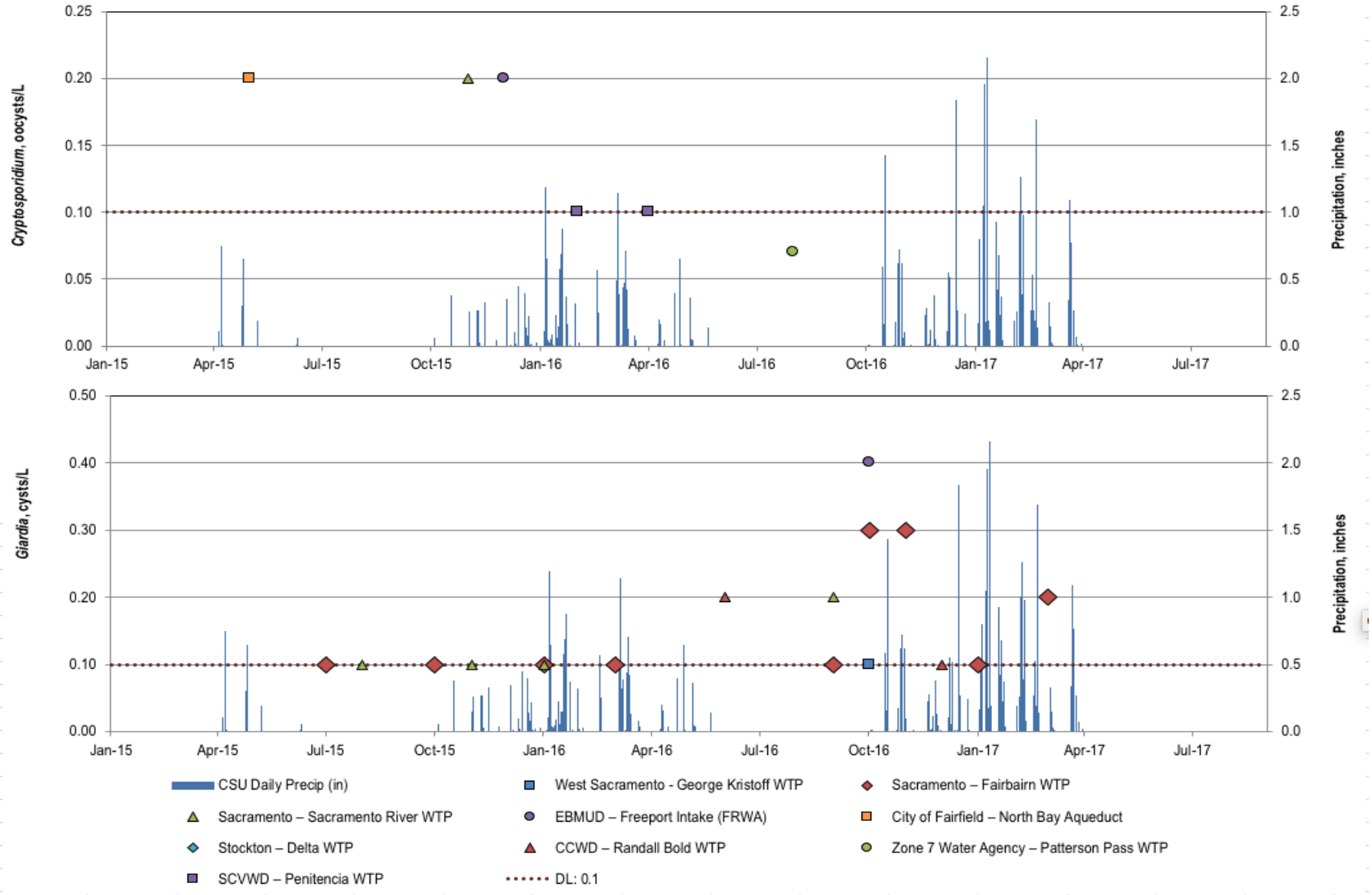

Figure 4. Drinking Water Intake Detected *Cryptosporidium* and *Giardia* Concentrations by Event/Rainfall

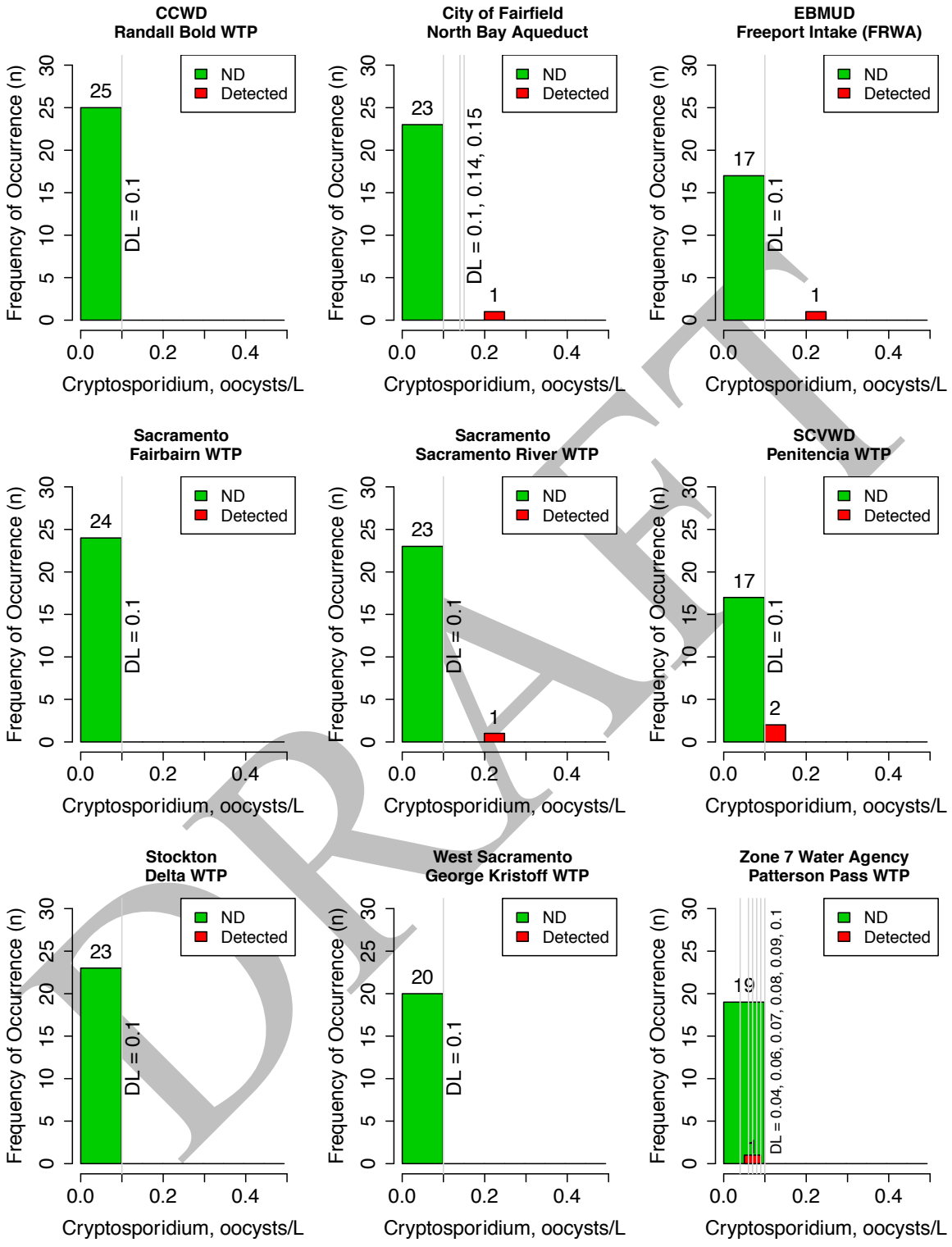

Figure 5. Drinking Water Intake *Cryptosporidium* Results by Site

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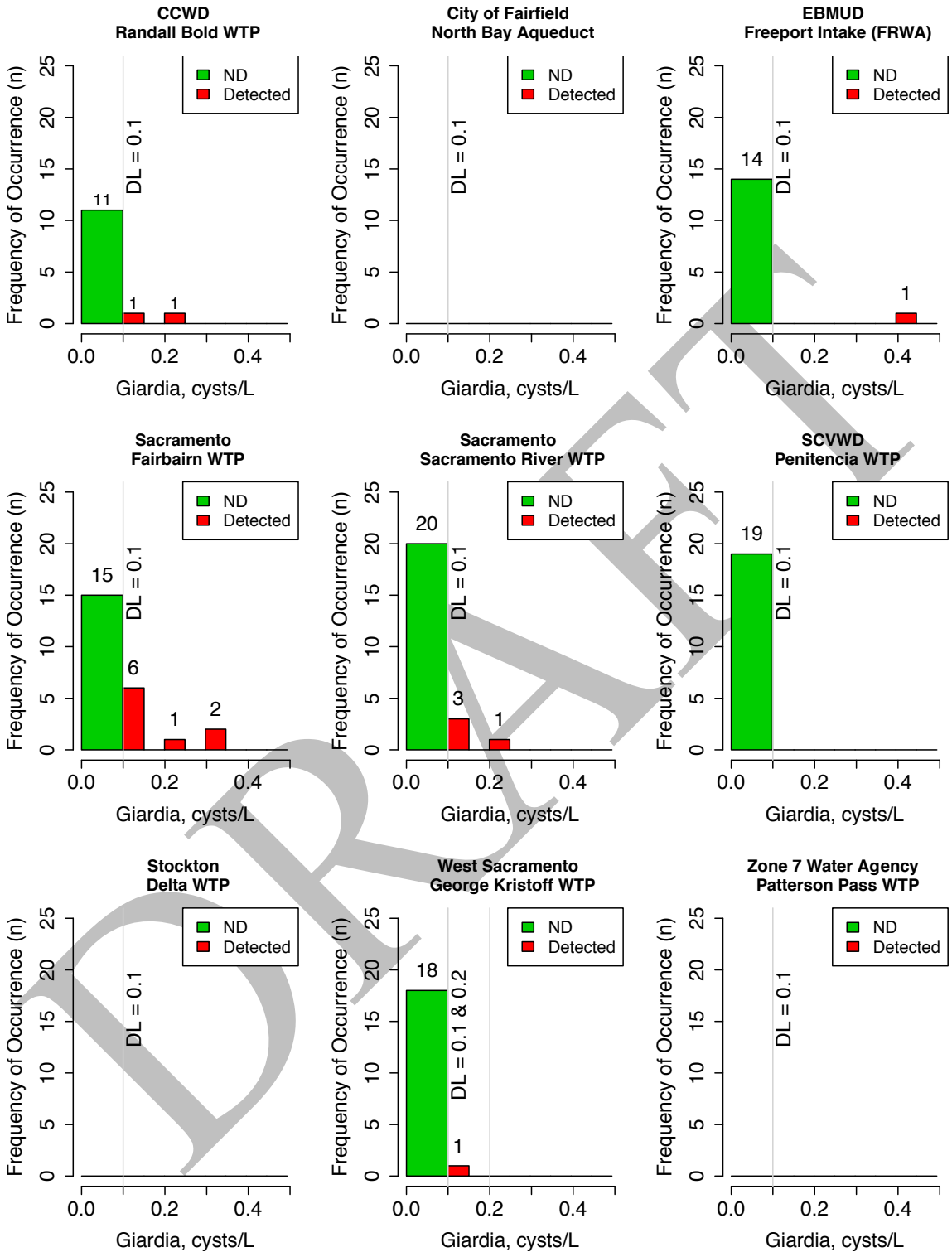

Figure 6. Drinking Water Intake *Giardia* Results by Site

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3.2 Ambient Results

The ambient sampling data are presented along with incremental rainfall data (**Figure 7)** and by site (**Figure 8** and **Figure 9).** Similar to the intake results, the ambient data indicate that the most frequent detections occurred during the late summer to fall time period during both study years. Several intense rain events occurred during the study period; however, those events did not correlate with detected pathogens.

Cryptosporidium was detected at nearly half of the ambient locations, with more frequent detections generally at the outer edges of the Delta. However, the highest concentration was detected in the Sacramento River at Hood (with both detections occurring in September or October, before the first annual wet season event, but during the rice drainage season). *Giardia* detections were more widespread, and data suggest that *Giardia* is more frequently detected, and detected at higher concentration, in the tributaries to the Delta relative to the mainstream Delta locations, though no robust statistical comparison was performed.

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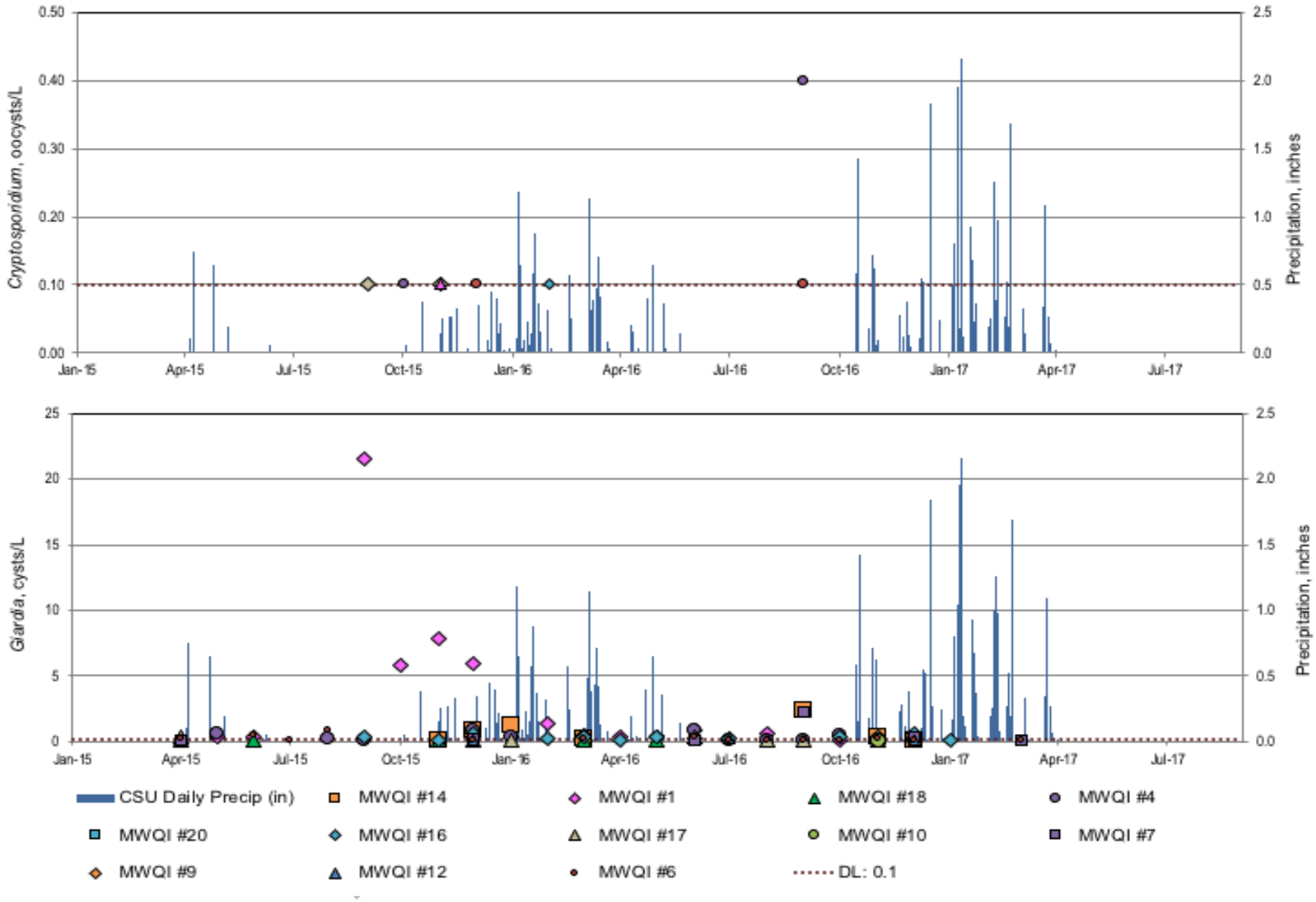

Figure 7. Detected Ambient *Cryptosporidium* and *Giardia* Concentrations by Event/Rainfall

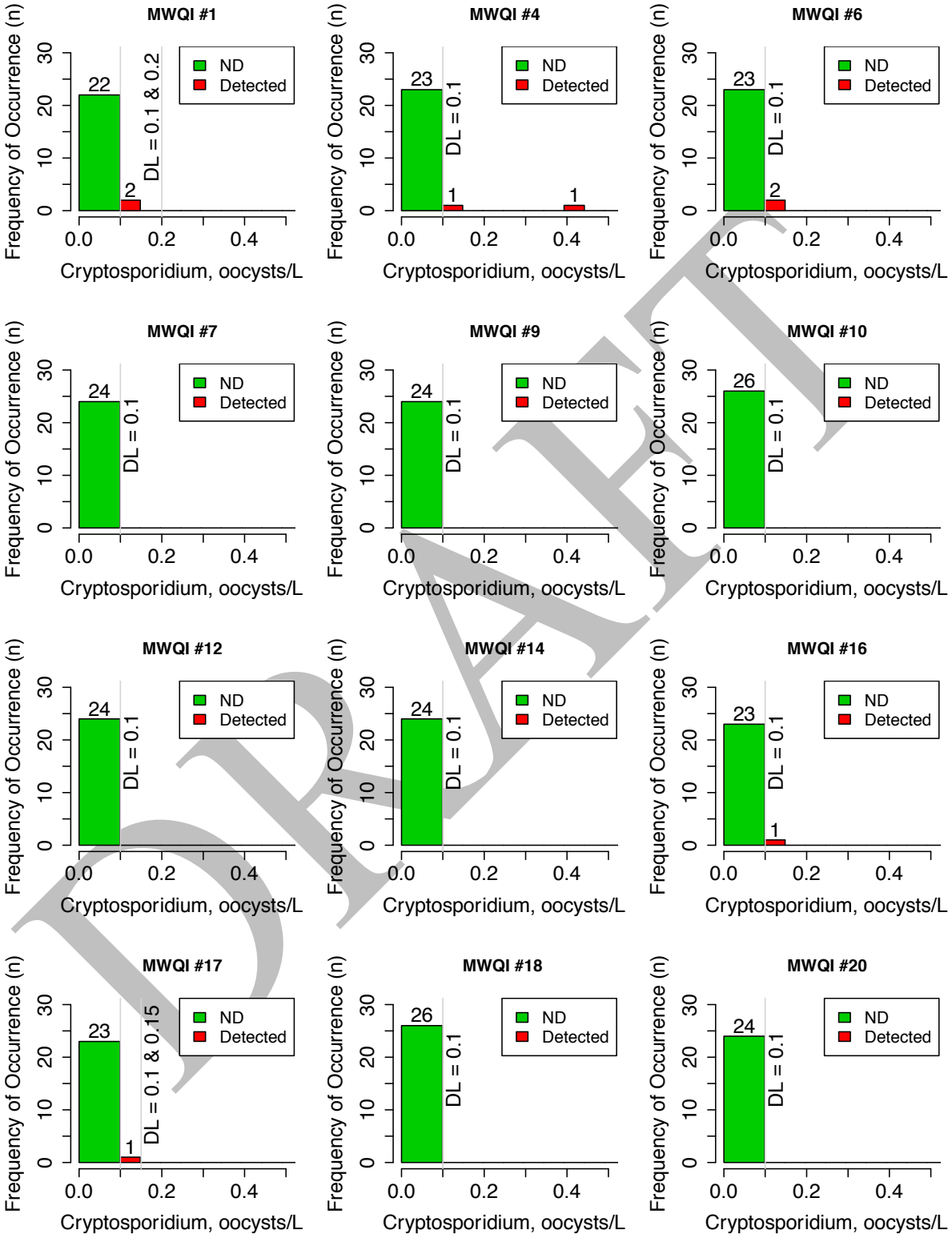

Figure 8. Ambient *Cryptosporidium* Results by Site

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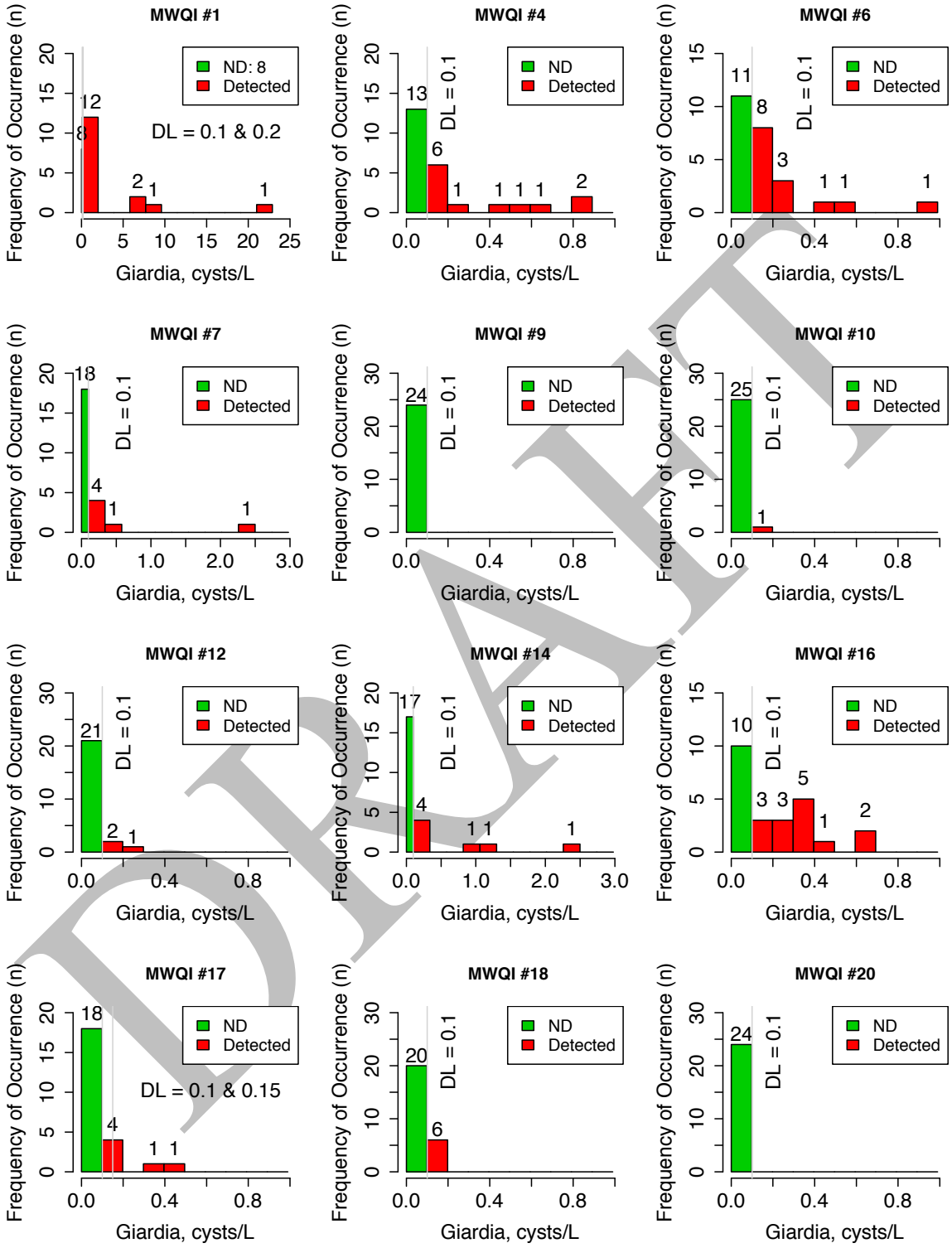

Figure 9. Ambient *Giardia* Results by Site

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3.3 Data Quality Evaluation

In addition to the laboratory quality assurance (QA) program quality control (QC) samples were collected to measure the accuracy and precision of the reported results. The Pathogen Study collected matrix spike (MS) samples to assess matrix interference with the analytical method, and field duplicates to assess field precision and sample variability. In addition, the analytical laboratory performed internal control analyses of their Ongoing Precision and Recovery (OPR) samples, a component of internal lab QC for Method 1623, which involve weekly analyses of reagent water samples spiked with *Cryptosporidium* or *Giardia* oocysts/cysts to verify all performance criteria. The complete QC sample results are included in **Appendix B**, and the MS and laboratory OPR results are presented in **Table 8.**

Overall, the MS recoveries are within the range of those seen by drinking water agencies during the first round of LT2 sampling (2007), where the average MS recovery was 40% (USEPA, 2011). The MS recoveries for USEPA Method 1623 can be low, and variable depending on matrix effects, but these recovery levels are still deemed to be acceptable by LT2 measurement quality objective standards. The USEPA notes in their LT2 FAQ[7] that if the recovery rate of a MS sample is within the range of the quality control acceptance criteria identified in the analytical method (13% - 111%), the corresponding field sample is valid. The USEPA further notes that some source water matrices may make it difficult to meet the MS acceptance criteria. The USEPA accepts field samples that correspond with samples with low MS recovery for calculation of the *Cryptosporidium* bin calculation. The Pathogen Study was designed to maintain consistency with the LT2 program, which accounts for the known method recovery limitations.

3.3.1 Temporary Variance

The Pathogen Workgroup identified low matrix recoveries (<5% for *Cryptosporidium*) as a potential issue through the first three events, though laboratory QA was reported as acceptable based on the analytical method and LT2 data quality objectives, which do not consider matrix recoveries. As noted above, one key goal of the Pathogen Study was to maintain consistency with the LT2 program, which already accounts for the known method recovery limitations.[8] USEPA Method 1622 or 1623 is required for LT2 samples. The Pathogen Subgroup and the analytical laboratories identified an issue with the Immunomagnetic separation (IMS) beads used for USEPA Method 1623, an additional potential cause of the lower than expected recoveries, and developed a short-term action plan to better assess data quality and improve the understanding of the recovery limitations.

A temporary variance to the monitoring design was implemented during July and August 2015, reducing the number of sites and increasing the number of QA/QC samples collected. A

[7] USEPA FAQ for Public Water Systems Reporting/Compliance: https://safewater.zendesk.com/hc/en-us/articles/211399088-The-recovery-rate-of-a-matrix-spike-sample-is-below-the-quality-control-acceptance-criteria-identified-in-the-analytical-method-13-111-Is-the-corresponding-field-sample-valid-What-steps-should-be-taken-

[8] USEPA FAQ for Public Water Systems Reporting/Compliance: https://safewater.zendesk.com/hc/en-us/articles/211399088-The-recovery-rate-of-a-matrix-spike-sample-is-below-the-quality-control-acceptance-criteria-identified-in-the-analytical-method-13-111-Is-the-corresponding-field-sample-valid-What-steps-should-be-taken-

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memorandum[9] (See **Appendix C**) was submitted to the technical advisory committee (TAC), summarizing the issue and proposed approach. The variance was concluded after the laboratory received notification from the supplier that the IMS bead issue was resolved, and after the laboratory observed a return to typical OPR recovery results over two consecutive months.

Table 8. Ambient QA/QC Sample Results

Year	Month	Method	MS Sample Location	MS Recovery[a]		OPR Recovery[b]	
				Crypto.	*Giardia*	*Crypto.*	*Giardia*
2015	April	1623	MWQI #14	1%	1%	69%	62%
	May	1623	MWQI #1	0%	3%	22%	66%
	June	1623	MWQI #18	27%	1%	54%	84%
	July	1623	MWQI #18	0%	11%	53%	69%
		1623	MWQI #4	1%	15%	53%	69%
		1623.1	MWQI #4	0%	11%	68%	55%
	August	1623	MWQI #4	11%	74%	79%	90%
		1623	MWQI #6	17%	72%	79%	90%
		1623.1	MWQI #6	21%	64%	72%	81%
		1623 by Eurofins	MWQI #6	32%	71%	57%	47%
	September	1623	MWQI #16	32%	87%	82%	80%
	October	1623	MWQI #17	41%	70%	77%	81%
	November	1623	MWQI #10	76%	83%	71%	86%
	December	1623	MWQI #7	76%	81%	74%	85%
2016	January	1623	MWQI #9	1%	20%	75%	71%
	February	1623	MWQI #12	65%	47%	79%	61%
	March	1623	MWQI #6	0%	0%	74%	62%
	April	1623	MWQI #14	2%	3%	67%	82%
	May	1623	MWQI #1	13%	71%	74%	73%
	June	1623	MWQI #18	44%	81%	71%	69%
	July	1623	MWQI #4	0%	35%	75%	67%

[9] Larry Walker Associates, Inc. Temporary Variance to Delta Regional Monitoring Program Pathogen Monitoring Schedule to Evaluate Reagent Supply and Method Performance. Submitted to Aquatic Science Center, July, 2015.

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Year	Month	Method	MS Sample Location	MS Recovery[a]		OPR Recovery[b]	
				Crypto.	*Giardia*	*Crypto.*	*Giardia*
	August	1623	MWQI #20	34%	45%	71%	54%
	September	1623	MWQI #16	91%	85%	48%	52%
	October	1623	MWQI #17	25%	73%	70%	47%
	November	1623	MWQI #10	85%	75%	66%	73%
	December	1623	MWQI #7	25%	66%	60%	64%
2017	January	1623	MWQI #9	44%	74%	80%	68%
	February	1623	MWQI #12	1%	1%	86%	76%
	March	1623	MWQI #6	0%	2%	84%	84%

Notes:

[a] EPA Method 1623 defines the acceptance criteria for MS recovery as 13% to111% for *Cryprosporidium*, and 15% to 118% for *Giardia* (Section 9.5.1 of Method 1623; Tables 3 and 4). LT2 data quality objectives do not consider MS recoveries in determining the validity of a corresponding field sample.

[b] EPA Method 1623 specifies that OPR *Cryptosporidium* recovery should be from 11 percent to 100 percent, and OPR *Giardia* recovery should be from 14 percent to 100 percent to be considered acceptable (Section 9.7.3 of Method 1623; Tables 3 and 4)

4. CONCLUSIONS

The Pathogen Study did not find *Cryptosporidium* concentrations at any of the sites that triggered additional investigations or studies. The study also found that there are no immediate expected bin level changes for water supply intakes either in the Delta or immediately upstream of the Delta. As a result, no further actions or study are necessary. Overall, *Giardia* was detected more frequently than *Cryptosporidium* at both ambient and intake locations; however, the Basin Plan does not set a threshold for the evaluation of *Giardia* levels.

The RMP assessment questions, and their answers based on study results, are presented in **Table** 9.

Table 9. RMP Assessment Questions and Study Conclusions

Assessment Question	Study Conclusion
ST1 Are current pathogen levels supportive of the municipal drinking water quality beneficial use as described in the Basin Plan?	
A. Are the current pathogen levels for each Delta water intake and those immediately upstream (i.e., Sacramento Area) different than the previous LT2 sampling? Are any drinking water intakes reclassified into a higher bin level?	No, there are no significant changes to pathogen levels compared to the previous LT2 sampling. Drinking water intakes would be classified the same (Bin Level 1) as in previous LT2 monitoring.
B. Are Basin Plan trigger values exceeded?	No, results were all below the Basin Plan trigger values for the WTPs evaluated.

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Assessment Question	Study Conclusion
SPLP1 Can any changes in bin level be attributed to an identifiable event, condition, or changes in a source?	
A. What are the concentrations in ambient waters upstream or downstream from intakes with observed changes to bin levels?	N/A, no bin level changes were observed
B. What are the concentrations in ambient waters upstream or downstream from intakes with observed changes to bin levels?	
C. What is the influence of sources (agriculture, POTWs, urban runoff, upstream tributary, natural, recreation, and other) on pathogen levels at drinking water intakes?	
D. Are there new discharges or changes in sources or conditions that could explain the change in bin level compared to previous LT2 monitoring?	
SPLP2 What is the viability and infectivity of pathogens at drinking water intakes?	
A. What percentage of *Cryptosporidium* found in ambient waters and source waters can cause infection?	N/A, no study was triggered
SPLP3 What are the factors affecting decay and growth rates and can they be quantified and characterized for the purpose of modeling?	
A. Is there recent research or literature on the environmental fate of **Cryptosporidium** and *Giardia* that can be used to develop decay/growth rates in models?	N/A, no study was triggered
B. What are the observed changes in *Cryptosporidium* and *Giardia* concentrations as a pulse of ambient water or source water moves through the watershed and Delta?	N/A, no study was triggered

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Appendix A. Drinking Water Intake and Ambient Data

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Location ID	Description	Source(s) Represented	Rationale for Inclusion	2015									2016											2017					
				April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	March	# Detects	Max	Mean
MWQI #14	Colusa Basin Ag Drain	Agriculture	Source representation	<0.1	<0.1	<0.1	NS	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	------	0
				<0.1												<0.1													
MWQI #1	Natomas East Main Drainage Canal	Stormwater, Agriculture	Source representation	<0.1	<0.1	<0.1	NS	NS	**0.1**	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	2	0.1	0.0091
					<0.1												<0.1												
MWQI #18	Sacramento River at Westin Boat Dock	Stormwater, Combined Sewer System	Proximity to intakes	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	------	0
						<0.1												<0.1											
MWQI #4	Sacramento River at Hood	Stormwater,Wastewater	General characterization	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.4**	<0.1	<0.1	<0.1	<0.1	<0.1	2	0.4	0.0208
																			<0.1										
MWQI #20	Cache Slough near Ryder Island	Wetlands	Source Representation	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	------	0
																				<0.1									
MWQI #16	Mokelumne River at Benson's		Input to Delta	<0.1	<0.1	<0.1	NS	NS	< 0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	0.1	0.0045
									< 0.1												<0.1								
MWQI #17	Calaveras River at UOP Footbridge	Stormwater	Source representation	<0.1	<0.1	<0.1	NS	NS	<0.1	< 0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.15	<0.1	1	0.1	0.0045
										< 0.1											<0.1								
MWQI #10	Rock Slough at CCWD Fish Facility		General characterization	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	< 0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	------	0
											< 0.1											<0.1							
MWQI #7	Old River at Bacon Island		General characterization	<0.1	<0.1	<0.1	NS	NS	<0.1	<0.1	<0.1	< 0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	------	0
												< 0.1											<0.1						
MWQI #9	Banks Pumping Plant		Export from Delta	<0.1	<0.1	<0.1	NS	NS	<0.1	<0.1	<0.1	<0.1	< 0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	------	0
													< 0.1											<0.1					
MWQI #12	Jones Pumping Plant		Export from Delta	<0.1	<0.1	<0.1	NS	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	------	0
														<0.1											<0.1				
MWQI #6	San Joaquin River near Vernalis		Input to Delta	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	NS	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	2	0.1	0.0083
														<0.1												<0.1			

Notes

NS Sites not sampled during the temporary sampling variance due to IMS reagent issues

Mean calculated using "0" for ND values, per LT2 guidance (*USEPA. 2006. Source Water Monitoring Guidance Manual for Public Water Systems for the Final Long Term 2 Enhanced Surface Water Treatment Rule. Office of Water. EPA 815-R06-005*)

Field duplicate results are shown under corresponding sample result

Location ID	Description	Source(s) Represented	Rationale for Inclusion	2015									2016											2017					
				April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	March	# Detect	Max	Mean
MWQI #14	Colusa Basin Ag Drain	Agriculture	Source representation	<0.1	<0.1	<0.1	NS	NS	<0.1	<0.1	**0.1**	**0.9**	**1.2**	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	**2.4**	<0.1	**0.3**	**0.1**	<0.1	<0.1	<0.1	7	2.4	0.22
				<0.1												<0.1														
MWQI #1	Natomas East Main Drainage Canal	Stormwater, Agriculture	Source representation	<0.1	**0.4**	**0.3**	NS	NS	**21.5**	**5.8**	**7.9**	**5.9**	**0.4**	**1.4**	**0.5**	**0.3**	<0.1	**0.8**	<0.1	**0.6**	<0.1	**0.1**	**0.2**	<0.1	<0.1	<0.2	<0.1	14	22	1.94
					0.3												**0.4**													
MWQI #18	Sacramento River at Westin Boat Dock	Stormwater, Combined Sewer System	Proximity to intakes	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	**0.1**	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	5	0.1	0.02
						0.1												<0.1												
MWQI #4	Sacramento River at Hood	Stormwater,Wastewater	General characterization	<0.1	**0.6**	<0.1	<0.1	**0.2**	**0.1**	<0.1	<0.1	**0.8**	**0.4**	<0.1	<0.1	<0.1	<0.1	**0.8**	<0.1	**0.1**	**0.1**	**0.5**	**0.1**	**0.1**	<0.1	<0.1	<0.1	11	0.8	0.15
																			0.1											
MWQI #20	Cache Slough near Ryder Island	Wetlands	Source Representation	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		0
																				<0.1										
MWQI #16	Mokelumne River at Benson's		Input to Delta	<0.1	<0.1	<0.1	NS	NS	**0.3**	<0.1	**0.1**	**0.6**	<0.1	**0.2**	**0.3**	**0.1**	**0.3**	**0.2**	**0.2**	<0.1	<0.1	**0.3**	**0.4**	**0.6**	**0.1**	<0.1	<0.1	13	0.6	0.17
									0.3												<0.1									
MWQI #17	Calaveras River at UOP Footbridge	Stormwater	Source representation	**0.4**	<0.1	<0.1	NS	NS	<0.1	< 0.1	<0.1	**0.1**	**0.1**	<0.1	<0.1	<0.1	<0.1	**0.3**	<0.1	**0.1**	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.15	<0.1	6	0.4	0.05
										< 0.1												<0.1								
MWQI #10	Rock Slough at CCWD Fish Facility		General characterization	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	< 0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	1	0.1	0.004
											< 0.1												<0.1							
MWQI #7	Old River at Bacon Island		General characterization	**0.1**	<0.1	<0.1	NS	NS	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	**2.3**	<0.1	<0.1	**0.4**	<0.1	<0.1	**0.1**	6	2.3	0.13
												< 0.1												<0.1						
MWQI #9	Banks Pumping Plant		Export from Delta	<0.1	<0.1	<0.1	NS	NS	<0.1	<0.1	<0.1	<0.1	< 0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		0
													< 0.1											<0.1						
MWQI #12	Jones Pumping Plant		Export from Delta	<0.1	<0.1	<0.1	NS	NS	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	3	0.2	0.02
													<0.1												<0.1					
MWQI #6	San Joaquin River near Vernalis		Input to Delta	**0.2**	<0.1	**0.5**	**0.1**	**0.9**	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	NS	**0.4**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.1**	<0.1	<0.1	<0.1	14	0.9	0.13
															0.2												**0.1**			

Notes

NS Sites not sampled during the temporary sampling variance due to IMS reagent issues

Mean calculated using "0" for ND values, per LT2 guidance (*USEPA. 2006. Source Water Monitoring Guidance Manual for Public Water Systems for the Final Long Term 2 Enhanced Surface Water Treatment Rule. Office of Water. EPA 815-R06-005*)

Field duplicate results are shown under corresponding sample result

Location ID	Description	Source(s) Represented	Rationale for Inclusion	2015												2016												2017												2018	Max Annual
				Jan	Feb	Mar	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Mean
West Sacramento - George Kostoff WTP	Sacramento River	Drinking water intake	Upstream of Sacramento urban area				NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					0
Sacramento – Fairbairn WTP	American River	Drinking water intake	In Sacramento urban area				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1										0
Sacramento – Sacramento River WTP	Sacramento River	Drinking water intake	In Sacramento urban area				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1										0.017
EBMUD – Freeport Intake (FRWA)	Sacramento River	Drinking water intake	Downstream of Sacramento urban area				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.2**	NS (1)	NS (1)	NS (1)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NS (1)	NS (1)	NS (1)										0.017
City of Fairfield – North Bay Aqueduct	Barker Slough	Drinking water intake	North Delta water with some local watershed runoff in wet season				<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.15	<0.1	<0.1	<0.1										0.017
Stockton – Delta WTP	San Joaquin River	Drinking water intake	In eastern Delta				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NS(1)	NS(1)	NS(1)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1										0
											<0.1									<0.1																				
CCWD – Randall Bold WTP	Western Delta/Los Vaqueros Reservoir	Drinking water intake	In western Delta				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1										0
Zone 7 Water Agency – Patterson Pass WTP	South Bay Aqueduct	Drinking water intake	100% Delta water in South Bay Aqueduct	< 0.09	NS	< 0.04	<0.08 (2)	<0.08	<0.07	<0.07	<0.07	<0.08	< 0.06	NS	NS	NS	NS	NS	< 0.07	< 0.08	<0.10	<0.1	**0.07**	<0.08	<0.08	<0.08	< 0.07												0.006
								<0.08																																
SCVWD – Penitencia WTP	South Bay Aqueduct	Drinking water intake	Blend of South Bay Aqueduct and Lake Del Valle				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1														0

Notes:

NS Not sampled

(1) Do not sample during the months when they are not drawing water from the Delta

(2) Lab failed QC. Resampled in May

Field duplicate results are shown under corresponding sample result

Location ID	Description	Source(s) Represented	Rationale for Inclusion	2015									2016										2017										2018
				April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
West Sacramento - George Kristoff WTP	Sacramento River	Drinking water intake	Upstream of Sacramento urban area	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Sacramento – Fairbairn WTP	American River	Drinking water intake	In Sacramento urban area	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	**0.3**	**0.3**	<0.1	**0.1**	<0.1	**0.2**									
Sacramento – Sacramento River WTP	Sacramento River	Drinking water intake	In Sacramento urban area	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1									
EBMUD – Freeport Intake (FRWA)	Sacramento River	Drinking water intake	Downstream of Sacramento urban area	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NS	NS	NS	NS (2)	NS (2)	NS (2)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.4**	<0.1	<0.1	NS (2)	NS (2)	NS (2)									
City of Fairfield – North Bay Aqueduct	Barker Slough	Drinking water intake	North Delta water with some local watershed runoff in wet season	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)									
Stockton – Delta WTP	San Joaquin River	Drinking water intake	In eastern Delta	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)									
CCWD – Randall Bold WTP	Western Delta/Los Vaqueros Reservoir	Drinking water intake	In western Delta	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.1	<0.1	NS	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	NS	<0.1								
Zone 7 Water Agency – Patterson Pass WTP	South Bay Aqueduct	Drinking water intake	100% Delta water in South Bay Aqueduct	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)	NA(1)											
SCVWD – Penitencia WTP	South Bay Aqueduct	Drinking water intake	Blend of South Bay Aqueduct and Lake Del Valle	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1											

Notes:

NA(1) Not Applicable. Do not analyze for Giardia

NS Not Sampled

(2) Do not sample during the months when they are not drawing water from the Delta

Field duplicate results are shown under corresponding sample result

Appendix B. QA/QC Data

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Year	Month	Method	MS Sample Location	MS Recovery		OPR Recovery		Sample		Field Dup				Lab Dup			
				Crypto.	*Giardia*	*Crypto.*	*Giardia*	*Crypto.*	*Giardia*	*Crypto.*	RPD	*Giardia*	RPD	*Crypto.*	RPD	*Giardia*	RPD
2015	April	1623	Colusa Basin Ag Drain	1%	1%	69%	62%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	May	1623	Natomas East Main Drainage Canal	0%	3%	22%	66%	<0.1	**0.4**	<0.1	0%	**0.3**	**29%**	ND	0%	**1.4**	**111%**
	June	1623	Sacramento River at Westin Boat Dock	27%	1%	54%	84%	<0.1	<0.1	<0.1	0%	**0.1**	N/A	ND	0%	ND	0%
	July	1623	Sacramento River at Westin Boat Dock	0%	11%	53%	69%	<0.1	<0.1								
		1623	Sacramento River at Hood	1%	15%	53%	69%	<0.1	<0.1					ND	0%	**0.1**	N/A
		1623.1	Sacramento River at Hood	0%	11%	68%	55%	<0.1	<0.1								
	August	1623	Sacramento River at Hood	11%	74%	79%	90%	<0.1	<0.1								
		1623	San Joaquin River near Vernalis	17%	72%	79%	90%	<0.1	**0.2**					ND	0%	**0.2**	0%
		1623.1	San Joaquin River near Vernalis	21%	64%	72%	81%	<0.1	<0.1								
		Eurofins MS	San Joaquin River near Vernalis	32%	71%	57%	47%										
	September	1623	Mokelumne River at Benson's Ferry	32%	87%	82%	80%	<0.1	**0.3**	<0.1	0%	**0.3**	0%	ND	0%	ND	N/A
	October	1623	Calaveras River at UOP Footbridge	41%	70%	77%	81%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	November	1623	Rock Slough @ CCWD Fish Facility	76%	83%	71%	86%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	December	1623	Old River at Bacon Island	76%	81%	74%	85%	<0.1	**0.2**	<0.1	0%	<0.1	N/A	ND	N/A	**0.2**	0%
2016	January	1623	Banks Pumping Plant	1%	20%	75%	71%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	February	1623	Jones Pumping Plant	65%	47%	79%	61%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	March	1623	San Joaquin River near Vernalis	0%	0%	74%	62%	<0.1	<0.1	<0.1	0%	**0.2**	N/A	ND	0%	ND	0%
	April	1623	Colusa Basin Ag Drain	2%	3%	67%	82%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	**0.8**	N/A
	May	1623	Natomas East Main Drainage Canal	13%	71%	74%	73%	<0.1	<0.1	<0.1	0%	**0.4**	N/A	ND	0%	**0.8**	N/A
	June	1623	Sacramento River at Westin Boat Dock	44%	81%	71%	69%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	July	1623	Sacramento River at Hood	0%	35%	75%	67%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	**0.1**	N/A
	August	1623	Cache Slough nr Ryer Island	34%	45%	71%	54%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	September	1623	Mokelumne River at Benson's Ferry	91%	85%	48%	52%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	October	1623	Calaveras River at UOP Footbridge	25%	73%	70%	47%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	November	1623	Rock Slough @ CCWD Fish Facility	85%	75%	66%	73%	<0.1	<0.1	<0.1	0%	**0.1**	N/A	ND	0%	ND	0%
	December	1623	Old River at Bacon Island	25%	66%	60%	64%	<0.1	<0.1	<0.1	0%	**0.4**	N/A	ND	0%	**0.2**	N/A
2017	January	1623	Banks Pumping Plant	44%	74%	80%	68%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	**0.1**	N/A
	February	1623	Jones Pumping Plant	1%	1%	86%	76%	<0.1	<0.1	<0.1	0%	<0.1	0%	ND	0%	ND	0%
	March	1623	San Joaquin River near Vernalis	0%	2%	84%	84%	<0.1	<0.1	<0.1	0%	**0.1**	N/A	ND	0%	ND	0%

Appendix C. Temporary Variance Memorandum

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MEMORANDUM

LARRY WALKER ASSOCIATES

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DATE: July 15, 2015

TO: Phil Trowbridge, Aquatic Science Center
Thomas Jabusch, Aquatic Science Center

CC: Delta Regional Monitoring Program Technical Advisory Committee
Elaine Archibald, Archibald Consulting

DRAFT

SUBJECT: **TEMPORARY VARIANCE TO DELTA REGIONAL MONITORING PROGRAM PATHOGEN MONITORING SCHEDULE TO EVALUATE REAGENT SUPPLY AND METHOD PERFORMANCE**

The Pathogen Subgroup to the Delta Regional Monitoring Program (RMP) Technical Advisory Committee (TAC) designed and is assisting in the implementation of a pathogen monitoring work plan (Pathogen Study). The Pathogen Study is based on the monitoring needs specified in the Sacramento River Basin and San Joaquin River Basin Water Quality Control Plan (Basin Plan). The Pathogen Study coordinates "external" Long Term 2 Enhanced Surface Water Treatment Rule (LT2) monitoring performed by water agencies between April 2015 and April 2017 with the Delta RMP "ambient" monitoring at key locations in and tributary to the Delta. In this way the Delta RMP ambient monitoring can support investigations and follow-up related to any identified changes in water intake pathogen (*Cryptosporidium* or *Giardia*) concentrations based on the LT2 reporting and assessment criteria. The Pathogen Subgroup performed an initial quality control (QC) review of the first three sample results collected by the Delta RMP from April 2015 through June 2015.

The Pathogen Subgroup identified low matrix recoveries (<5% for *Cryptosporidium*) as a potential issue through the first three events, though laboratory QC were acceptable based on the analytical method and LT2 measurement quality objectives, which do not consider matrix recoveries. One key goal of the Pathogen Study was to maintain consistency with the LT2 program, which already accounts for the known method recovery limitations. Environmental Protection Agency (EPA) Method 1622 or 1623 are required for LT2 samples. The Pathogen Subgroup and the analytical laboratories identified an additional potential cause of the lower than

expected recoveries and developed a short term action plan to better assess data quality and improve the understanding of the recovery limitations.

This memorandum describes the expected short-term issue with the immunomagnetic separation (IMS) beads used for EPA Method 1623, the Delta RMP sample recoveries, and the recommended modifications to the sampling analysis approach.

IMS Bead Recovery Issue

EPA summarized (see Attachment A) the occurrence of a nationwide production problem with the reagent (IMS beads) used for Method 1623. The manufacturer (IDEXX) expects the problem to be resolved before August 2015. In the meantime, labs have been noting inconsistent recoveries in their Ongoing Precision and Recovery (OPR) samples, with some recoveries reduced to half of the historical performance level. The OPR samples are a component of internal lab QC for Method 1623, which involve weekly analyses of reagent water samples spiked with *Cryptosporidium* or *Giardia* oocysts/cysts to verify all performance criteria. The issue with inconsistent OPR sample recoveries applies to all LT2 work nationwide. EPA is working with laboratories to evaluate the *Cryptosporidium* and *Giardia* recoveries associated with various lots of IMS beads (Attachment A).

The primary Delta RMP and LT2-approved laboratory (BioVir) OPR results are typically >60%, but they have noted much lower OPR results for batches of IMS beads used during April-June. 2015 BioVir OPR performance is shown in Table 1.

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Table 1. BioVir 2015 Ongoing Precision and Recovery (OPR) Results

BioVir Sample No.	Week No.	Date	% Giardia	% Crypto	Negative Staining Control Result
150001	1	01/05/15	57.58	61.62	neg
150054	3	01/12/15	42.42	62.63	neg
150095	4	01/19/15	39.39	63.64	neg
150112	5	01/23/15	42.00	62.63	neg
150153	6	02/02/15	79.00	80.81	neg
150194	7	02/10/15	57.00	81.82	neg
150223	8	02/16/15	47.00	56.57	neg
150262	9	02/23/15	63.00	58.59	neg
150293	10	03/02/15	59.00	54.55	neg
150321	11	03/09/15	76.00	76.77	neg
150421	13	03/25/15	62.63	70.71	neg
150476	15	04/06/15	61.62	68.69	neg
150537	15	04/09/15	40.00	52.53	neg
150599	16	04/17/15	57.00	28.28	neg
150604	17	04/20/15	65.00	23.23	neg
150752	19	05/06/15	52.00	16.16	neg

BioVir Sample No.	Week No.	Date	% Giardia	% Crypto	Negative Staining Control Result
150761	19	05/08/15	65.00	19.19	neg
150761	19	05/14/15	67.00	69.70	neg
150795	20	05/14/15	68.00	71.72	neg
150801	21	05/18/15	79.00	69.70	neg
150801	21	05/18/15	63.00	80.81	neg
150801	21	05/18/15	53.00	57.58	neg
150839	21	05/21/15	84.00	56.57	neg
150866	22	05/27/15	69.00	22.22	neg
150943	23	06/01/15	84.00	53.54	neg
150943	23	06/01/15	24.00	24.24	neg

Delta RMP Matrix Spike Recoveries

The Pathogen Subgroup review of the initial quality control data for the pathogen study identified low matrix spike (MS) recoveries, though laboratory QC (OPR sample recovery) was acceptable based on the LT2 measurement quality objectives. Matrix spike samples are ambient water samples spiked with a known quantity of *Cryptosporidium* or *Giardia* oocysts/cysts, and then analyzed to determine the effect of the matrix on the method's oocyst/cyst recovery. The first two MS samples were collected from sites with potentially more complex and variable matrices (Natomas East Main Drain and Colusa Basin Ag Drain) than the main-stem Delta locations. However, without additional information, it is not possible to confirm whether recovery problems are related to the reagent, site-specific matrix interference or other lab issues. The matrix spike sample recoveries and laboratory OPR performance for the first three months of sample collection are shown in Table 2.

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Table 2. Matrix Spike (MS) and Laboratory Ongoing Precision and Recovery (OPR) Performance

		MS Recovery		OPR Recovery	
Month	**Location**	***Cryptosporidium***	***Giardia***	***Cryptosporidium***	***Giardia***
April	Natomas East Main Drainage Canal	1%	1%	69%	62%
May	Colusa Basin Ag Drain	0%	3%	22%	66%
June	Sacramento River at Westin Boat Dock	27%	1%	54%	84%

Modified Sampling and Analysis Approach

The Pathogen Study was designed to maintain consistency with the LT2 program, which already accounts for the known method recovery limitations. The matrix spike recoveries for EPA Method 1623 can be low, but still acceptable by LT2 measurement quality objective standards. However, the Pathogen Subcommittee determined that additional investigation of matrix

recoveries, LT2-allowable method modifications, and alternate laboratories could inform changes to the Pathogen Study and better quantify uncertainty in the results.

The Pathogen Study is constrained to the current Delta RMP budget and cost-neutral sample collection modifications include the following:

- Reduce the total number of sites to five, limiting them to the main-stem of the Delta where the matrices are less complex and less variable and would have potentially better recovery rates. Each of the main stem sites will be sampled each month as shown in Table 3 as "active" sites.
- Conduct additional QA/QC samples to evaluate the method performance, and to compare BioVir and Eurofins performance.
    - Collect matrix spike samples from two locations per event for BioVir to better assess recovery performance in different matrices,
    - Send a matrix spike sample from one of the matrix spike locations to Eurofins to assess inter-laboratory matrix spike recovery performance. These samples will be used to assess laboratory performance and inform Year 2 Pathogen Study planning.
    - Collect an additional inter-method field duplicate and matrix spike for BioVir to analyze using Method 1623.1. Method 1623.1 is a modification to 1623 that has been shown to improve Cryptosporidium recovery by >20%. Method 1623.1 is allowed for LT2 use. These samples will assess method performance and provide a basis for any recommended changes.

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The Pathogen Subcommittee recommends following this modified sampling approach at least through August 2015. The decision to switch back to the original sampling plan will be adaptively managed based on the results from these additional QA analyses, and on the resolution of the reagent issue with the manufacturer.

BioVir recently received new batches of IMS beads, and the OPRs have improved (>80%). The Pathogen Subcommittee will wait until consistent OPR results are observed before reverting to the original sampling approach. The modified sampling approach will allow evaluation of the performance of method 1623.1, with a replicate field sample and MS to be analyzed using both 1623 and 1623.1 at one location.

Table 3. RMP Pathogen Study Monitoring Locations

Location ID	Description	Short Term Status
MWQI #14	Colusa Basin Ag Drain	Inactive through August 2015
MWQI #1	Natomas East Main Drainage Canal	Inactive through August 2015
MWQI #18	Sacramento River at Westin Boat Dock	Active
MWQI #4	Sacramento River at Hood	Active
MWQI #20	Cache Slough near Ryder Island	Active
MWQI #16	Mokelumne River at Benson's Ferry	Inactive through August 2015
MWQI #17	Calaveras River at UOP Footbridge	Inactive through August 2015
MWQI #10	Rock Slough at CCWD Fish Facility	Active

MWQI #7	Old River at Bacon Island	Inactive through August 2015
MWQI #9	Banks Pumping Plant	Inactive through August 2015
MWQI #12	Jones Pumping Plant	Inactive through August 2015
MWQI #6	San Joaquin River near Vernalis	Active

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Table 4. Short Term Quality Control Sample Collection Schedule

		BioVir Method 1623			BioVir Method 1623.1		Eurofins Method 1623	
Location ID	**Location Description**	**Field Sample [1]**	**Matrix Spike**	**Second Matrix Spike**	**Inter-Method Duplicate**	**Matrix Spike**	**Inter-Lab Duplicate**	**Matrix Spike**
MWQI #18	Sacramento River at Westin Boat Dock	X	June[2]	July[2]				
MWQI #4	Sacramento River at Hood	X	July[2]	Aug.	July[2]	July[2]	July[2]	July[3]
MWQI #6	San Joaquin River near Vernalis	X	Aug.	Sept.	Aug.	Aug.	Aug.	Aug.
MWQI #20	Cache Slough near Ryder Island	X	Sept.	Oct.	Sept.	Sept.	Sept.	Sept.
MWQI #10	Rock Slough at CCWD Fish Facility	X	Oct.		Oct.	Oct.	Oct.	Oct.

Notes:
[1] Field samples are collected at every active location in Table 3 each month.
[2] Monitoring has been completed for this event.
[3] Matrix spike was not analyzed due to laboratory error.
Schedule is provisional and likely will continue through August 2015, pending Pathogen Subcommittee review

DRAFT

Attachment A.

Environmental Protection Agency Correspondence

Rick Zimmer

From: Miller, Carrie <Miller.Carrie@epa.gov>
Sent: Tuesday, April 28, 2015 2:11 PM
To: Miller, Carrie
Subject: LT2 Monitoring for Cryptosporidium

To All Concerned:

It has come to TSC's attention that some laboratories are experiencing lower than usual crypto recovery in their quality control (QC) samples. Several laboratories and vendors are actively investigating the issue which appears to be a synergistic effect between some of the method reagents. TSC will follow up when we have more conclusive information about the cause of the recovery issue and will share any advice we become aware of as to how laboratories may address it.

Laboratories performing analyses for the LT2 follow Method 1622, 1623 or 1623.1 and any sample in a batch associated with unacceptable quality control samples is unacceptable. Per the LT2 "SOURCE WATER MONITORING GUIDANCE MANUAL FOR PUBLIC WATER SYSTEMS:"[1]

If a PWS is unable to report a valid analytical result for a scheduled sampling date due to equipment failure, loss of or damage to the sample, failure to comply with the analytical method requirements, including the quality control requirements in 40 CFR § 141.704 or the failure of an approved laboratory to analyze the sample, the PWS must collect a replacement sample. The PWS must collect the replacement sample not later than 21 days after receiving information that an analytical result cannot be reported for the scheduled date, unless the PWS demonstrates that collecting a replacement sample within this time frame is not feasible or EPA/the State approves an alternative resampling date. The PWS must submit an explanation for the delayed sampling date to EPA/the State concurrent with the shipment of the sample to the laboratory [40 CFR § 141.702(b)(2)].

PWSs may contact their state representative, on the list accessed from the link below, and request an alternative resampling date.

http://water.epa.gov/lawsregs/rulesregs/sdwa/lt2/upload/lt2contactnov20141.pdf

[1]Information taken from section 3.2.2 in the Source Water Monitoring Guidance for Public Water Systems PDF (EPA 815-R06-005 February 2006)

Thank you,

Carrie Miller
Cryptosporidium Laboratory Technical Liaison
U.S. Environmental Protection Agency
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Materials for Agenda Item 12

Date: July 11, 2018 (revised September 12, 2018)

From: Donald Yee, ASC QA Officer and Matthew Heberger, Delta RMP Program Manager

To: Delta RMP Technical Advisory Committee

Re: Review of 2016-2017 Current Use Pesticide QA/QC Data

General summary

This memo summarizes the quality assurance (QA) review of the Delta Regional Monitoring Program (Delta RMP) Fiscal Year 2016–2017 (FY16/17) data for laboratory analyses of pesticides, copper, and ancillary measurements in water. This review was conducted by ASC scientists and technical staff under the supervision of QA Officer Dr. Donald Yee.

All samples were collected and analyzed by scientists and technicians at the U.S. Geological Survey (USGS). Staff of the USGS Pesticide Fate Research Group (PFRG), Organic Chemistry Research Laboratory (OCRL) in Sacramento, CA conducted both the field sampling and lab analyses for pesticides and conventional water quality parameters, under the supervision of Chief Chemist (CC) James Orlando. Samples were analyzed for a suite of Current Use Pesticides (CUP) at OCRL in Sacramento. Sample water was divided and subsamples were shipped to the USGS National Water Quality Laboratory (NWQL) in Denver, CO for analysis of dissolved organic carbon (DOC), particulate organic carbon (POC), and copper. More information about how samples were collected and analyzed can be found in the program's 2016 pesticides data report.[1]

There were 2 DOC field samples not reported. Aside from that, we found that 100% of the lab results for field samples were reportable (not rejected), although most of the pesticides were not detected in most samples.

Copper showed variable recoveries in matrix spikes, deviating more than the QAPP-specified average ±25% from target values, despite good recovery in lab control samples (a clean matrix).

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[1] Jabusch, T., P. Trowbridge, M. Heberger, J. Orlando, M. De Parsia, and M. Stillway. "Delta Regional Monitoring Program Annual Monitoring Report for Fiscal Year 2015–16: Pesticides and Toxicity."Richmond, CA: San Francisco Estuary Institute – Aquatic Science Center, 2018. http://www.sfei.org/documents/delta-pesticides-2016.

This suggests possible interferences with the copper analysis in natural matrix samples, so field sample results for copper were qualified.

At the end of this memo, Table 1 summarizes the results of the QA review.

Approach

About 20% of all reported records were for quality assurance and quality control purposes.

For this review, we, the project data management team (DMT) and project QA Officer (QAO), used the data electronically submitted by the laboratories and compiled it into a local database to first verify that the correct number of field samples and required number of QC samples are reported for the requested analyses.

We then compared the results for QC samples to the acceptance criteria, or measurement quality objectives (MQOs) listed in the program's Quality Assurance Program Plan (QAPP).[2] We did this by independently recalculating precision (as relative percent difference, RPD, or relative standard deviation, RSD) for lab replicates, and percent recovery for samples with known expected concentrations[3]. In order to verify that contamination of samples had not occurred in sampling or lab analysis, we compared the results for blank samples (both field and lab blanks) to method detection limits. In cases where an analyte is detected in a blank, we compared the measured concentration in the blank sample to concentrations measured in in field samples to determine the proportion of the signal that originates from lab contamination.

Where deviations from the project MQOs were found, we attached a flag or qualifier to the record. In some cases, records may have already been flagged by the reporting lab. Qualifiers added by ASC or the lab indicate that there has been a deviation from the project's quality criteria, and are meant to warn data users that certain records may be inaccurate or imprecise, or otherwise may need to be interpreted with caution. When the code is added by ASC rather than by the lab, it is preceded by a 'V'.

If data not meeting MQOs were not flagged by the laboratory, the DMT and QAO communicate with the laboratory to verify the reported data contain no transcription errors, missed

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[2] Jabusch, Thomas, Don Yee, and Amy Franz. "Delta Regional Monitoring Program Quality Assurance Program Plan, Version 2.2." San Francisco Estuary Institute – Aquatic Science Center, September 30, 2016. https://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/delta_regional_monitoring/wq_monitoring_plans/2016_0930_drmp_qapp.pdf.

[3] Most labs calculate these metrics as a part of their internal QA, to identify lab performance outside of their usual controls. We request labs submit these metrics along with the data, however, we independently recalculate them to identify issues such as miscoded samples or transcription errors.

conversions or similar errors. If necessary, corrections are made to the data during this process. Otherwise, the data are flagged by the QAO (QA codes in the database that start with letter "V" are applied by QAO rather than the lab). Systematic problems with the analysis or reporting of data are discussed with the lab to identify appropriate corrective actions for either re-reporting the samples or for future analyses. In the most severe cases, data may be rejected and not reported. However, for this project, all data were reportable, as we did not find serious violations of the quality objectives that would lead to rejection of data.

A more detailed narrative of the review of QC data submitted by the labs is presented below.

USGS OCRL – Current Use Pesticides

The section below describes the QA of current use pesticide data analyzed at the USGS Organic Chemistry Research Laboratory (OCRL). See Table 1 at the end of this memo for a summary of the QA review.

General findings and *recommended actions*

All of the laboratory data were reportable (not rejected) for the target analytes.

There was initially low precision (RPD > 70%) for two pesticides, due to the mistaken reporting by the lab of field blanks as being field replicates. There were also results sporadically omitted from submissions requiring followup to determine the reasons for omission. Recoding and resubmission of the data fixed these errors, but created extra work, first in finding the seemingly low precision, then in reanalyzing the QC after the resubmission. ***The lab should work on internal procedures to better ensure that the submitted data is both complete and matches what they have recorded internally.***

Completeness

All of the expected results were reported by the lab. Results were reported for 152 compounds in dissolved phase and 130 in particulate phase. The lab reported all expected results from regular field samples (for each analyte: n = 60, 12 monthly samples at 5 stations) plus field replicates (minimum 5% frequency or n = 3 samples for each analyte).

Blanks and matrix spikes/duplicates (MS/MSDs) were also reported at a minimum 5% frequency (3 or more of each). For MS/MSDs this is in accordance with the DRMP QAPP, but for blanks this may be less than 1 per 20 "or batch". Batches without blanks were therefore flagged in BatchVerificationCode "VQI" for incomplete QC. All pesticides were non-detect in all blanks, so the impact of fewer blanks may not be severe.

Hold times

All of the samples were prepared/preserved within less than 24 hours, well within the 48 hour hold time limit. Samples were analyzed within the QAPP required 30 days after preparation so no results were flagged for hold time.

Sensitivity

About 80% of the target analytes were non-detect in all the dissolved or particulate samples. About 18% of pesticides were detected in less than half the samples, with only 2% of the analytes detected in half or more of the samples. This is expected, as most pesticides, if used properly, should only be found at low concentrations in the environment. Records in the database with results below their respective MDLs (reported in the same record) should not be regarded as fully quantitative as explained in the following paragraph.

The OCRL computes method detection limits (MDLs) for pesticide compounds it analyzes following standard analytical chemistry methods as outlined in two publications.[4] Chemists at the OCRL follow best practice in reporting results when they can be reasonably certain the compound is present in the sample, even when the concentration of a chemical is below the calculated and published MDL. These results have a greater uncertainty, and data users are cautioned that the result should be considered an estimate. This communication is done via the database in two ways. First, the database field ResultQualCode is assigned the value "ND" for non-detect. Second, the field QACode is assigned the value JA (Analyte positively identified but quantitation is an estimate) or JDL (Estimated result lower than detection limit). In total, 86 results were reported but flagged because the result was lower than the MDL. These results accounted for less than 0.5% of the 18,754 chemistry results.

Blank contamination

Accurate measurement of analytes at low concentrations sometimes requires correcting for background sources of contamination, such as traces in reagents, solvents, glassware, or other sample processing hardware used in the analysis. Analyzing "method blanks" or "lab blanks" lets us demonstrate that these materials are free from contamination that would interfere with analysis of the sample. No pesticides were found in any of the lab blank or field blank samples. Therefore, no blank qualifiers were needed. All pesticides results are reported without blank correction.

Results less than three times the computed concentration in a blank have a high probability of not being quantitative, as the measured blank(s) can account for a third or possibly more of the

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[4] Hladik, Michelle, Kelly L. Smalling, and Kathryn Kuivila. "Methods of Analysis-Determination of Pyrethroid Insecticides in Water and Sediment Using Gas Chromatography/Mass Spectrometry." Techniques and Methods 5 – C2. US Geological Survey, 2009. https://pubs.usgs.gov/tm/tm5c2/tm5c2.pdf.

Hladik, Michelle, and Daniel L. Calhoun. "Analysis of the Herbicide Diuron, Three Diuron Degradates, and Six Neonicotinoid Insecticides in Water-Method Details and Application to Two Georgia Streams." Scientific Investigations Report 2012–5206. US Geological Survey, 2012. https://pubs.usgs.gov/sir/2012/5206/pdf/sir20125206.pdf.

total signal. Table 1 shows that no results were <3x the blank, so it is unlikely that a majority of the total signal in any sample is from blank contamination.

Precision

The precision of analysis methods (ability to consistently obtain the same result) is determined by analyzing replicate samples. The lab analyzed "laboratory replicates" (where the field sample is split in the laboratory and each subsample is analyzed separately) to assess the repeatability of measurements. Further, field crews collected "field replicates" (two or more samples collected in the same place at the same time) to demonstrate lack of contamination in the field. For most analytes, we would like replicate samples to be within 25% (RPD or RSD) of one another; the acceptance ranges are specified as the MQOs in the QAPP Table 4.3. However, most analytes were never detected in any sample, so we could not estimate precision for those in unspiked field samples.

Because of this, we evaluated precision primarily based on the results of matrix spike duplicates (MSDs), where two samples are each spiked with a known amount of a contaminant. In general, we found that there was a good agreement between these paired samples, with an average RPD of 15% or less for all analytes, well within the target 25%.

Azoxystrobin and boscalid initially had RPDs over 100%, due to samples with switched IDs. This was corrected on a later resubmission.

Table 1 reports the range of precision estimates for the various analyte groups. Rather then reporting the QA measurement for all 152 pesticide analytes, we have reported the average and the range for the compounds in the particulate phase, and in the dissolved phase measured with different instruments and methods (LC/MS vs. GC/MS). We estimated precision using the relative percent difference (RPD) when only a pair of replicates for a given sample. However, when there are 3 or more replicates, there are multiple pairwise comparisons possible, so we report relative standard deviation (RSD) instead as an indicator of the spread of the distribution in measurements. (The use of both RPD and RSD to measure precision follows SWAMP protocols.)

Accuracy

We estimate the lab's accuracy, or the closeness of a measured result to an accepted reference value by measuring the percent recovery of a compound in a sample that is "spiked" with a known quantity of a chemical. Recoveries were evaluated from matrix spike samples, with average deviation less than the 25% target limit in the QAPP. Therefore, we did not flag any results for recovery problems. This provides evidence that the results of the lab analysis are reasonably accurate.

Comparison to previous data

As a final check on the data, we compare the results to those from similar studies, or to results from previous years. This is a qualitative check that lets us see whether results are out of the ordinary and may require some followup investigation. In general, the lab results for pesticide measurements were consistent with those found in year 1. Of the 10 analytes that were detected in more than half the samples in the first year, 6 were also found in more than half the samples in Year 2, and the remaining 4 were detected in between 25 to 50% of samples.

Other Analytes – DOC, POC, Copper, and TSS

The following section gives a summary of the QA for analytes other than pesticides. These include analyses performed by the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado for dissolved organic carbon (DOC), particulate organic carbon (POC), and copper. This section also describes the QA for total suspended solids (TSS) analyzed by the Organic Chemistry Research Laboratory (OCRL) in Sacramento.

General findings and *recommended actions*

Nearly all of the field data were reportable for the target analytes. We did not reject or censor any data because of quality concerns, but two expected records were lost in processing and not reported by the lab, with insufficient material for reanalysis. Both missing records were for DOC. According to the lab manager, these samples were lost during sample processing at the NWQL. Reruns of the samples were requested but there was not enough sample material remaining. ***To diagnose and help prevent future occurrences, reports should be sent to the PM after each sampling round with counts of all field samples and field QC provided to analytical labs. The data manager should also check preliminary submissions for counts (as well as other QC sample types) and confirm with submitting lab, to minimize piecemeal additions of missing data and reformatting/re-evaluation.*** Matrix spike recoveries for copper were variable, despite good recoveries on lab control (blank) spikes, suggesting possible interference in analysis of natural matrix samples.

Hold time

Hold time was met for ~~most~~ all analyses ~~aside from 1 TSS sample, which was analyzed 33 days after collection, past the recommended 7 day hold time. This result was flagged for hold time exceedance by the lab (HT flag), but not censored. The organic portion of TSS is typically similar to that in sediment (<10% of total mass), so the impact of possible sample TSS degradation would likely be of that magnitude (<10%)~~so no added flags were needed.

Completeness

The dataset includes 60 site event combinations (12 months, 5 sites) for 2016–2017, reported for POC, copper, and TSS. The lab failed to report two expected results for DOC (~3% of the expected total). Missing samples were:

- At Ulatis Creek at Brown Road (site code 511ULCABR) on 2016-07-13
- At Mokelumne River at New Hope Road (site code 544SAC002) on 2016-08-17

The lab reported three or more filter blanks and laboratory control samples (LCSs), with the number of filter blanks varying by analyte, ~~but with all~~ meeting or exceeding the required 1 per 20 (5%) frequency in the QAPP, but not necessarily the "or batch" condition.~~.~~ Thus batches without blanks or recovery samples were therefore flagged in BatchVerificationCode "VQI" for incomplete QC. Blanks were nearly all non-detects, and recovery for most analytes met QAPP targets, so the impact of fewer QC samples may not be severe.

The lab only submitted only 2 MS/MSD pairs for copper. This is one less of each type of QA sample than specified in the QAPP. We have communicated this with the lab. There may have been confusion resulting from initial submission of the first 3 months of Year 2 data with Year 1, and erroneously counting of some of those samples as applying to Year 2.

Feld replicates were reported (at 5% frequency, n = 3) for DOC, POC, and copper, and TSS, and 3 or more lab replicates (of field grab samples) were reported for copper and DOC. ***The project manager should monitor the minimum number of field replicates noted by field crews, and the data manager should check preliminary submissions for counts (as well as other QC sample types) and confirm with submitting lab.***

Sensitivity

Methods were generally sufficient to quantify the target conventional and metal analytes in nearly all the samples; only total nitrogen, a non-target analyte was ND in 3% of samples.

Blank contamination

A trace amount of copper was detected in one of the filter blanks at 0.32 µg/L, just above the MDL of 0.2 µg/L. Since all field sample copper concentrations were at least 3x higher than the blank result in that batch (which contained the Dec 2016 and Jan 2017 samples), those results were flagged for blank contamination (VIP flag) but not censored.

Precision

Variation among TSS field replicates was greater than sought in the QAPP, averaging RPD ~31%, over the 25% target. The project manager should continue to work in conjunction with field crews and labs to discuss alternative sampling and subsampling methods and strategies to minimize variation in TSS. Otherwise, the variation in TSS may make it of limited use for interpreting site characteristics and processes. RPDs on replicates averaged less than 10% for DOC and copper, and less than 25% for POC, meeting the QAPP requirements. Precision on MS and laboratory control samples (LCS) replicates was similar or even better, averaging <10% RPD for both DOC and copper.

Accuracy

LCS recoveries were generally good for DOC, with average errors <10%, well within the targets specified in the QAPP. There were no LCS or other recovery samples for POC, but TPC (total particulate carbon) recoveries would be most analogous, and also averaged <10% error. However, although average copper recovery in MS/MSD samples was 122%, it was variable, with average deviation of 32%, greater than the 25% target in the QAPP. Copper LCS samples had much better recovery, averaging 3% error, suggesting the problem is an interference found only in natural matrix samples. All copper results were therefore flagged but not censored for recovery deviations.

Dissolved and particulate phases

Of the conventional analytes, only organic carbon was analyzed in more than one fraction (dissolved and particulate). DOC was generally > POC, with median and mean ratios of around 5:1. However, a few samples had POC > DOC, which might be needed to interpret if anomalies are found in field data for pesticides and other pollutant chemicals at those sites.

Comparison to previous data

Average results for DOC and copper are consistent with those found in year 1, but POC and TSS averaged about 40% lower than prior results; since the latter are both particulate phase, similar/proportional differences would be expected.

Table 1. Summary of QA data

Method	Fraction	Analyte		% Exceeding hold time	% Non-detects	% Results <3x Blank	Average % Recovery for Matrix Spike Samples[1]	Acceptable range for recovery (MQO in QAPP)	Precision: Average RPD or RSD for Duplicate Samples[9]	Acceptable range for precision (MQO in QAPP)
Hladik and Calhoun, 2012 (anayzed by LC/MS/MS)	Dissolved	Pesticides	minimum[2]	0%	22%	0%	77%	70% - 130%	2.6%	< 25%
			average[3]	**0%**	**85%**	**0%**	**90%**		**5.4%**	
			maximum[2]	0%	100%	0%	105%		8.3%	
Hladik, et. al., 2008 (analyzed by GC/MS)	Dissolved	Pesticides	minimum	0%	24%	0%	77%	70% - 130%	1.0%	<25%
			average	**0%**	**96%**	**0%**	**97%**		**4.2%**	
			maximum	0%	100%	0%	109%		9.9%	
Hladik, et. al., 2008 (analyzed by GC/MS)	Particulate	Pesticides	minimum	0%	90.5%	0%	79%	70% - 130%	0.7%	<25%
			average	**0%**	**99.88%**	**0%**	**93%**		**4.1%**	
			maximum	0%	100%	0%	104%		12%	
USGS I-2020-05	Dissolved	Copper		0%	0%	0%	122%	75% - 125%	7.4%	< 25%
METH011.00	Dissolved	Dissolved Organic Carbon[4]		0%	0%	0%	103%	80% - 120%	10%	< 25%
EPA 440	Particulate	Carbon, Total		na[6]	0%	0%	99%	not stated[8]	21%	not stated[8]
EPA 440	Particulate	Nitrogen, Total		na[6]	3%	0%	99%	not stated[8]	1.5%	not stated[8]
EPA 440	Particulate	Particulate Organic Carbon[5]		0%	0%	0%	na[7]	na[7]	21%	< 25%
EPA 440	Particulate	Total Inorganic Carbon		na[6]	94%	0%	na[7]	na[7]	na[10]	not stated[8]
EPA 160.2M/Calculated	Particulate	Total Suspended Solids		2%	0%	0%	na[7]	na[7]	31%	< 25%

[1]Average % recovery across all batches, calculated by averaging the average recoveries from all individual batches.
Minimum and maximum % average recoveries represent the analytes with the lowest and highest average of averages.

[2]"Average" pesticide results for all analytes within the method considered collectively.

[3]"Min" and "Max" results for individual compounds, e.g., the fewest NDs for any one compound by LC/MS/MS was
25.4%, while the most was 100%ND (this occurred for many individual compounds, given that the average is 85.07%ND).

[4]DOC samples were used to represent lab recovery and precision for all dissolved carbon species.

[5]Total particulate carbon samples were used to represent lab recovery and precision for particulate carbon species.

[6]No hold time requirements listed for total carbon, total nitrogen, or total inorganic carbon.

[7]No spiked samples were analyzed for particulate organic carbon, total inorganic carbon, or total suspended solids, nor were any required by the QAPP.
Although matrix samples can be spiked to measure recovery, it is not commonly done by analytical labs.
Recovery of particulate total carbon provides some indication of measurement accuracy for the other carbon species.

[8]No MQO listed in the QAPP for total carbon or total nitrogen. These were not "target parameters" of our study,
but are analyzed by the lab in the course of performing other analyses and reported at no cost to us, and are reported here for the sake of completeness.

[9]Lab replicates were used to calculate precision by preference; for some pesticide analytes, where lab replicates were all non-detects, precision was calculated using field replicates.

[10]No replicates were analyzed or usable. For total inorganic carbon only field replicates were analyzed and
all results were non-detect, so RPD/RSD could not be calculated.

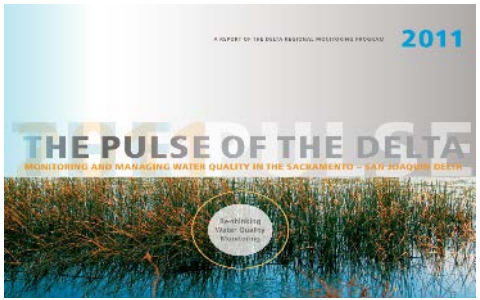
Materials for Agenda Item 14

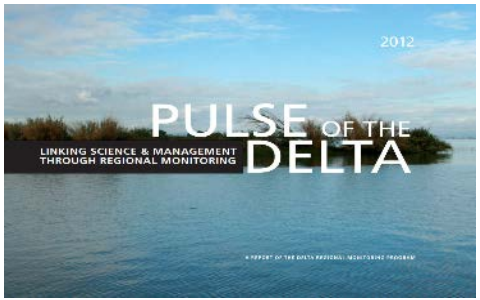
Planning *The Pulse of the Delta*
(and other external communication products)

Delta RMP Annual Joint Meeting
October 29, 2018

Background

Two *Pulses* have been published to date, but both preceded the creation of the Delta RMP.





“The vision for the Pulse of the Delta is to make the wealth of available information on water quality in the Delta accessible to water quality managers, decision-makers, scientists, and the public.” (Pulse of the Delta 2011)

Planning for the next Pulse of the Delta

FY17-18 Workplan:

“A Pulse document typically requires having 3-4 technical reports completed and approved by the Steering Committee a 9-12 months in advance, after which the Steering Committee works on high level messaging.”

Delta RMP Communications Plan:

“The Steering Committee will plan the scope, allocate funding, and decide when to publish a Pulse of the Delta and its theme.”

In 2017, we opted to delay the report

- **Decision:** Wait until we have more substantive content, publish in Fall 2019
- Allows more time for review, building consensus around key messages
- Major synthesis reports of nutrients completed in 2018
- Pesticides Interpretive Report expected April 2019
- In time for the *State of the Estuary* Conference

Audiences

Primary

- RMP participants
  - And your boards and colleagues

Secondary

- Other Bay managers
- Policy makers
- Local scientists
- Scientists in general
- Media and outreach specialists
- The public
- Funders

Options for Scope and Themes

Option A

Scope:
Delta RMP focused
data and accomplishments

Possible Themes:

Delta RMP data fill critical management needs

Option B

Scope:
Delta RMP and Key Partners
data and accomplishments

Possible Themes:

Delta RMP data complement other programs to fill critical data gaps

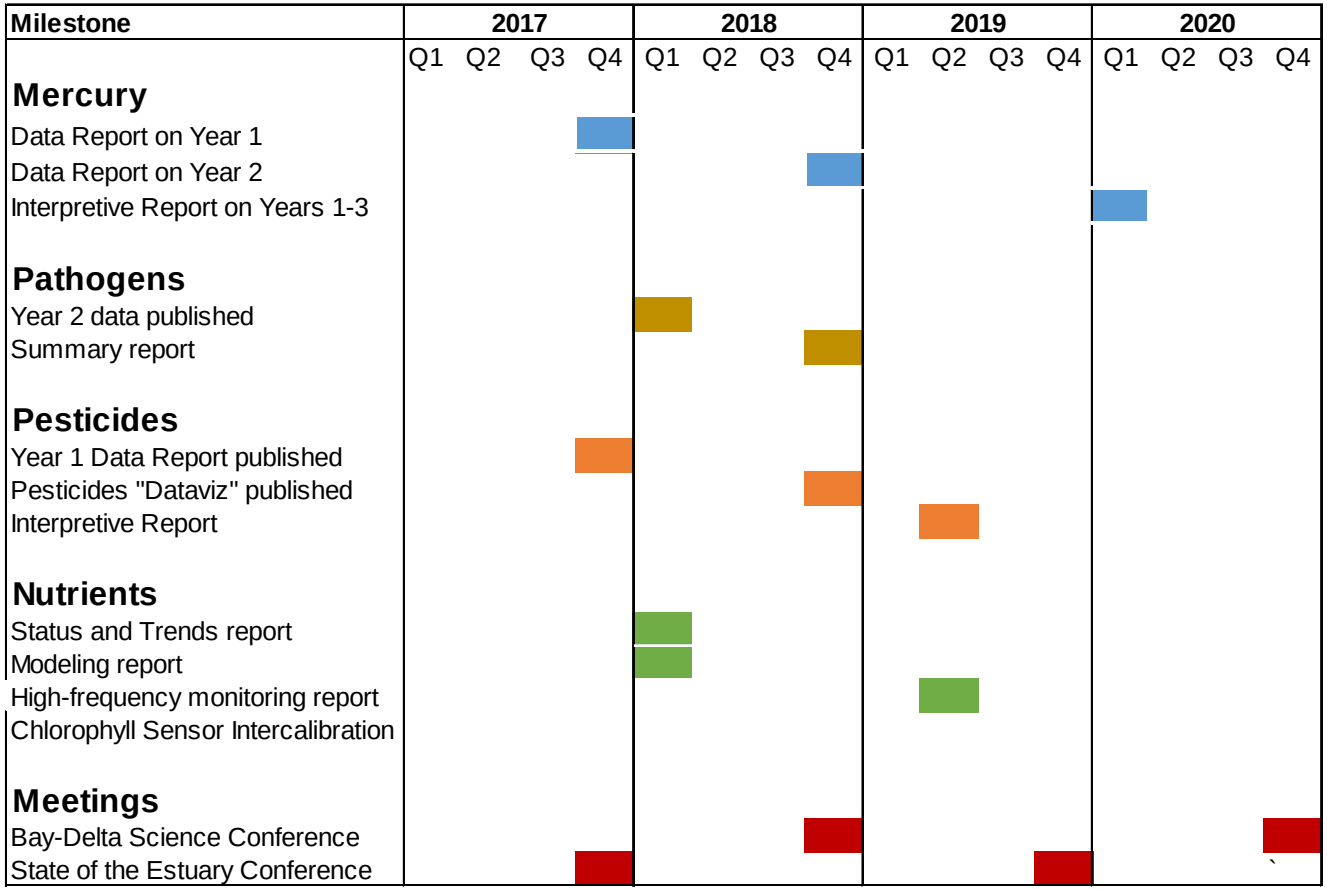
Option C

Scope:
Water Quality in the Delta

Possible Themes:

Status and trends of water quality in the Delta

Delta RMP Milestones



Example Outline

1. **Overview** - Introduction to this year's theme
2. **Management Update**
   a. How the RMP is informing management decisions
   b. Highlights of recent accomplishments
   c. Future direction
3. **Feature Articles**
   a. Mercury
   b. Nutrients
   c. Pesticides
   d. Pathogens
4. **Key Status and Trends Infographics**
   a. (if not covered in Section 3)
5. **Acknowledgments**
   a. Program Participants
   b. Contractors
   c. Key Partners
6. **References**

Updated Scope of Work & Budget

Scope of Work and Schedule

No.	Task	Schedule
1	Develop a detailed outline and scope with RMP committees Prepare a comprehensive budget and schedule	December 31, 2018
2	Manage subcontractors	June 30, 2019
3	Develop draft content	June 30, 2019
4	Manage comments/review by RMP committees	June 30, 2019

Unfunded tasks include:

- Graphic design
- Printing
- Outreach/Communications

Budget remaining:
$38,800
(out of $40,000 budget)

External Contributions

If we want to include data from key partners, who would that be?

- Environmental Monitoring Program (EMP)
- Municipal monitoring
- ILRP monitoring
- USGS

Mercury

We have one year of data collected but no published reports to date. Schedule:

Deliverable	**Due Date**
Final Data Report on Year 1	*Published 2018*
Draft Data Report on Year 2	December 2018
Final Data Report on Year 2	March 2019
Draft Interpretive Report on Years 1-3	December 2019
Final Interpretive Report on Years 1-3	March 2020

Pathogens

Year 1 data published and Year 2 data forthcoming (soon).

Data reports summarizing 2 years of *Cryptosporidium* and *Giardia* sampling in the Delta, by Larry Walker and Associates, release date late 2017, early 2018?

Current Use Pesticides

1. *Annual Monitoring Report FY 2015–16: Pesticides*. (Year 1 data report). In press, publication pending Steering Committee approval in October 2017.
2. Note: Year 2 data report cancelled at direction of the SC.
3. Pesticides Interpretive Report - estimated completion Spring 2019 (?).

Nutrients

USGS Reports:

- **2017** - An introduction to high-frequency nutrient and biogeochemical monitoring for the Sacramento–San Joaquin Delta, northern California
- **2017** - Synthesis of data from high-frequency nutrient and associated biogeochemical monitoring for the Sacramento–San Joaquin Delta, northern California
- **2017** - Designing a high-frequency nutrient and biogeochemical monitoring network for the Sacramento–San Joaquin Delta, northern California
- **Forthcoming in 2019**: Cross-Delta monitoring using high-frequency monitoring tools

ASC Reports:

- **2015** - Characterizing and quantifying nutrient sources, sinks and transformations in the Delta: synthesis, modeling, and recommendations for monitoring
- **2016** - Nutrient Monitoring Planning Workshop - Summary of Existing Nutrient Monitoring Programs, Data Gaps, and Potential Delta RMP "No Regrets" Monitoring Activities
- **2018** - Assessment of Nutrient Status and Trends in the Delta in 2001–2016: Effects of drought on ambient concentrations and trends.
- **2018** - Delta RMP Nutrients Synthesis: Modeling to Assist Identification of Temporal and Spatial Data Gaps for Nutrient Monitoring.